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NEW YORK, SATURDAY, MARCH 24, 1900.

CONTENTS.

	Page
Editorial	423
Metropolitan in Control of Third Avenue Railway, New York	426
Gas and Electricity	426
American Types of Automobiles—IX.—The Automobile Practice of the Riker Electric Vehicle Company	427
The Luminescence of Aluminum Electrodes, by W. S. Andrews	431
The Regulation of Storage Battery Voltage, by Roderick Macrae	431
Fundamental Ideas of Alternating Currents—II., by Prof. Dugald C. Jackson (concluded)	433
Electricity at the Pan-American Exposition, by Frank C. Perkins	436
The Telephone, Telegraph & Cable Co	438
More Subways in Boston	438
Report of the Massachusetts Gas & Electric Light Commissioners	438
Current News and Notes	439
LETTERS TO THE EDITORS:	
Short Circuit Curve of Alternators, by B. A. Behrend	441
Rationalization of Electrical Units, by W. E. Goldsborough	441
Digest of Current Electrical Literature, Compiled by Carl Hering	442
New Books	447
New Navy Standard Projectors	448
Direct-Connected Exhaust Fan with Detachable Motor	448
DEPARTMENTS:	
Financial Intelligence	449
Commercial Intelligence	450
Special Correspondence	452
Personal	454
Obituary	455
Trade Notes	456
Illustrated Record of Patents	457

THE THIRD AVENUE RAILWAY ABSORPTION.

That the Metropolitan Street Railway Company of New York would eventually obtain control of the Third Avenue Railway was almost inevitable, owing to the powerful financial backing of the former, the strategic position it occupied as a competitor, and the tendency of the times toward consolidating separate interests engaged in like lines of work. The announcement, however, came rather as a surprise at this time in view of the remarkable financial entanglements in which the affairs of the Third Avenue Company had become involved. The enormous financial burden which the receiver showed has been saddled upon the company was regarded by some as a serious obstacle to any satisfactory rehabilitation at the present time, but President Vreeland seems to be satisfied with the outlook, since he refers to it hopefully in an official announcement which we print in part on another page.

An important statement made by that official is that "a good many millions of the proposed expenditures of the Third Avenue Railway Company can be saved by using the power and plant of our company"—the Metropolitan. In explanation of this statement it may be said that as the Third Avenue plant was designed with an eye to the future, and at present needs but a relatively small amount of electric power—which is now being supplied by rotary converters belted to cable engines—the extra demand on the Metropolitan plant can readily be met. The Third Avenue Railway Company had contracted for the supply of electrical equipment for its new central power plant and substations, to the ultimate value of $5,000,000. These improvements, according to Mr. Vreeland's statement, will not be continued under the new condition of things. As the Third Avenue power house was to have been, when completed, the largest in the world, surpassing in capacity the huge plant of the Metropolitan Company by about 30-000 horse-power, its abandonment cannot but give rise to a feeling of professional regret on the part of engineers.

MASSACHUSETTS CENTRAL STATIONS.

The annual report for 1899 of the Massachusetts Board of Gas and Electric Light Commissioners shows, as in the case of the previous reports, that the central stations situated in the smaller towns of the Bay State are far from being profitable properties. Of the 62 electric lighting companies, 29 paid no dividends, and but 17—which number includes the larger companies—paid 6 per cent. or over, as follows: Nine companies, 6 per cent.; two companies, 7 per cent.; five companies, 8 per cent.; one company, 8 1-6 per cent. Comparing these figures with those for gas companies, we find that of the 68 gas companies in the state, 49 paid dividends. Of these but nine paid less than 6 per cent., and 17 paid 10 per cent. or more. During the year the total receipts of the gas companies were $6,334,000, a gain of 2 per cent. over the previous year; of this gross sum $1,488,900 were paid out as dividends. On the other hand, the total receipts of the central stations were $5,092,000, a gain of about 6 per cent. over the previous year, while the amount paid out in dividends was but $632,000, of which $443,000 were paid by the two great Boston central station companies at the rate of 6 and 8 per cent., respectively.

The report shows that there are now seventeen municipal electric lighting plants in the state of Massachusetts against which are charged $242,000 for operating expenses, interest and depreciation. From a table it appears that the cost per annum of 25-cp street incan-

descent lamps is $14.75, $22.48, $22.88, $25.62 and $30.28, respectively, for the five towns in which such lamps were used during the year. For 1200-cp arcs the following figures are given for eight towns: $73.12, $73.75, $83.30, $89.65, $89.91, $109.74 and $121.11. According to the table of prices paid for public lighting from plants in Massachusetts under private ownership, the rates for incandescent street lights in towns corresponding in size to those having municipal plants are from $12 to $16 per year, while those for arc lights are from $70 to $80 per year—falling below the former figure in several cases. If tax charges were added to the cost of municipal lights, the comparison, of course, would be still more unfavorable. It would thus appear that in Massachusetts, where one naturally expects to find the best showing from municipal ownership, the suppression or denial of private enterprise has, as a rule, resulted in a cost of public lighting much beyond what it would be under private ownership. That the economic truth involved in this condition is beginning to be recognized, seems to be indicated by the adverse action taken during the year by a number of Massachusetts towns on propositions to establish municipal electric lighting plants.

A PHENOMENON OF ALUMINUM-CARBON CELLS.

A curious experiment with aluminum-carbon cells is described on page 431 of this number. These cells, as is well known, have the remarkable property of interposing a very high electric resistance to one direction of current and a comparatively low resistance to the opposite direction of current, so that they serve to convert an alternating current into a unidirectional pulsating current with, however, a low efficiency, due care being taken not to exceed the limits of voltage imposed by the cell. The two cells of Mr. Andrews' experiment appeared to have had a resistance, in opposition series, of about 400 ohms when subjected to 100 volts, and about 100 ohms at 160 volts. The current is described as being accompanied by luminescence at the surface of the aluminum plates in a manner suggesting the hydro-electric forge. The activity at the points on the plates where the current breaks through the resisting film appears to be sufficiently great to raise the temperature locally to the point of luminescence.

ALTERNATING CURRENTS.

In this issue appears the concluding portion of the paper read by Prof. D. C. Jackson before the recent Convention of the Northwestern Electrical Association, and presenting the subject of alternating currents in a manner intended to appeal to those who have little or no knowledge of electrical science. The paper has been reprinted in these columns more for such value as it may possess in throwing side-lights on the subject of which it treats, than as an example of a method of exposition which can be approved except for the specific purpose for which this paper was written. The method of instruction by analogies is always a dangerous one, particularly if there is a probability that the audience addressed will not obtain a grasp of the subject sufficient for an appreciation of the limitations of the analogies employed. In the case of electricity, the danger is specially great when its etheric phenomena are illustrated with reference to phenomena of ponderable matter. To those, however, who desire merely a "speaking acquaintance" with electrical science sufficient for commercial needs, the method employed in the paper answers the purpose admirably.

METALLIC BRUSHES FOR ROTARY CONVERTERS.

The carbon brush, which has become such a universal fixture of electric generators and motors, has also been generally used on rotary converters, probably from force of habit on the part of the designers rather than by virtue of any special fitness for this purpose. In generators and motors the high resistance of the carbon brush has been necessary in order to avoid sparking under load changes and corresponding shiftings of the neutral points. In the rotary converter the position of the neutral remains fixed, regardless of changes of load, so that the high resistance of the carbon brush is not needed in this machine to enforce sparkless commutation. As is well known, the benefits of the carbon brush are obtained at the cost of considerable loss. In addition to the resistance of the material of the brushes themselves, there is a contact resistance between the face of the brush and the surface of the commutator, which resistance has a peculiar property of varying almost exactly in inverse ratio with the current density, so that the drop across this contact is nearly uniform regardless of the current flow. This drop with the usual material and conditions is from ¾ of a volt to 1¼ volts, making a total drop across the contacts of both the positive and negative brushes varying from 1½ to 2½ volts.

Rotary converters differ from direct-current generators in that their efficiencies are higher; hence the commutator losses are a much greater portion of the total waste of energy in the machine. For instance, large rotary converters commonly work at an efficiency of 95 or 96 per cent., their losses being little more than half of those of a mechanically-driven generator of the same size. With carbon brushes the losses of the commutator become a considerable part of the total losses of the machine. In a 125-volt machine the drop due to the contact resistance between the brushes and the commutator face may alone amount to 2 per cent. of the total output, in addition to which there is chargeable against the commutator almost all of the friction loss of the machine. With rotaries delivering higher voltages, the contact drop becomes a smaller proportion of the total e. m. f., and hence the waste becomes less, but it still remains a large part of the energy dissipated in the machine. With copper brushes the fall of voltage across the contacts can easily be kept down to a much smaller value, such as one-tenth of one volt.

A rotary also differs from a direct-current generator in having a much higher peripheral speed owing to the necessity that each part of the armature shall pass a large number of poles per second, and the difficulty of crowding the proper number of teeth and slots per pole in a very narrow space. Twenty-five cycle rotaries have a peripheral speed of about 5000 feet per minute and 60-cycle machines run considerably higher. In order to prevent the commutator segments from becoming too crowded and narrow, the commutators must have a diameter equal to about two-thirds of that of the armature, giving a peripheral commutator speed much higher than is customary in direct-current generators or motors. On this account the friction of the brushes becomes also a serious factor. The high speed also reduces the diameter and consequently the superficial area of the commutator from which the heating losses must be radiated, necessitating careful reduction of these losses to prevent overheating. The same high speed also involves another trouble in many cases where it becomes difficult to make the commutator segments of sufficient length to provide ample brush-bearing surface, the centrifugal force tending to buckle segments of too great a length or even to tear out their ends from clamping rings. The radial width of the brushes cannot, as a rule, be made as great as in generators, owing to the small polar pitch. For this reason, again, metal brushes are preferable to carbon brushes. On the other hand, accidents occasionally happen with rotaries which do not happen with generators, and which might be more disastrous with metal brushes than with those of carbon. Among such accidents is the dropping out of step, which causes severe arcing around the commutator, and which would do more damage to metal than to carbon brushes.

RECENT ELECTRICAL THEORIES.

Of very recent years a new physical and electrical theory of matter and its electrification has made its appearance, principally due to Prof. J. J. Thomson, and this theory has received considerable development in the paper by that scientist, appearing in the *Philosophical Magazine* for December, 1899, "On the Masses of the Ions in Gases at Low Pressures." Prof. Thomson has for some years called attention to the fact that the masses of flying matter, constituting the cathode rays in an excited Crooke's tube, are much smaller than the atoms of chemists and physicists; and that, moreover, these smaller chips or "corpuscles" of different substances seem to have similar properties. Thus a corpuscle of hydrogen does not appear to differ from a corpuscle of nitrogen. This theory, if it continues to gain favor and support from the accumulation of experimental evidence, bids fair to revolutionize our pre-existing ideas concerning matter and its electrical properties.

It had until recently been supposed that matter could not be divided more finely than into molecules, and that these were chemically divisible into atoms. But the atom was the end of all dissection, while an atom of iron was absolutely and completely distinct from an atom of some other substance, such as lead. Now it would seem that we can tear off minute chips from atoms, and that the chips so torn off lose identity and cannot be distinguished from one another. Of course, the suggestion naturally follows, as a matter of speculation, that if we could tear off a sufficient number of chips from the atoms of any substance, it might be possible to rearrange or reconstruct the chips in a new way, and possibly produce an atom of a different substance; or, in other words, that the process of tearing chips away from atoms is analysis of matter into "protyle," or the mother substance from which all chemical elementary substances may have been originally constructed.

Prof. Thomson's paper of December shows that matter exists in an ionized condition, or electrified state, in the cathode rays, in the neighborhood of an active incandescent lamp filament, and near the surface of a metallic reflector immersed in gas, upon which ultra-violet light falls. In each of these different cases the electric charge per gramme of the electrified substance is about 7,000,000 of C. G. S. magnetic units, or about 70,000,000 of coulombs, and it seems to be the same for different substances. In other words, the charge of a gramme of this negatively electrified matter in cathode rays, ultra-violet rays, or incandescent filament rays, is about 70 mega-coulombs, whether the electrified matter is air, hydrogen, or other gas. On the other hand, it has been well known ever since Faraday's researches, that the charge carried by a gramme of hydrogen ionized or electrified in an electrolyzed solution or plating bath is 9634 C. G. S. magnetic units, or, roughly, 100,000 coulombs—i. e., 0.1 mega-coulomb—and varies with the nature of the ion, being in inverse proportion to its electrolytic equivalent. In other words, the charge per *equivalent gramme* is constant in the ionized matter of electrolyzed solutions; whereas, the charge per *gramme* is constant, and about 700 times greater, in the ionized matter in cathode rays, ultra-violet light rays and incandescent filament discharges.

The question which arose from this result was, Whether the charge which an atom could carry in a cathode ray was greater than that which an atom could carry in an electrolyte; or whether the charge was the same in both cases, but the carrier was only a corpuscle in the cathode ray, and a full-sized atom in the electrolyte? To answer this question Prof. Thomson undertook to measure the charge on the ion produced by ultra-violet light on a zinc plate by a very pretty but intricate process, which involves the production of an artificial rain cloud in a chamber illumined by ultra-violet light shining on a zinc plate near the top of the chamber. The result showed that the ionic charge was 2×10^{-20} C. G. S. magnetic unit, or 2×10^{-19} coulomb. This agreed with the author's previous determination of the ionic charge in the case of cathode rays, and it also agrees with the ionic charge carried by monovalent elementary substances, such as hydrogen, in an electrolyzed solution. This appears to prove that the ionic charge or electric charge carried by an ion is always the same, whether the ion be in the electrolytic solution, in the negative ray, in ultra-violet rays, or in the stream of negatively charged matter emitted from an incandescent filament, and it is the mass of the ion which changes. The mass of the ion must, therefore, in the three last-named instances be about 700 times smaller than a mass of the atom and is a mere chip, or, as Prof. Thomson called it, a "corpuscle."

Some remarkable hypothetical inferences are drawn as a conclusion to the results of the paper. These are that an atom consists of corpuscles which are all equal, and the mass of a corpuscle is about 3×10^{-27} gramme, whereas the atom of hydrogen is supposed to have a mass about 700 times greater, or 2.2×10^{-24} gramme. Electrification of a gas consists in the splitting up of its atoms and the detachment of chips from them. The chip carries the negative electrical atom-charge of 2×10^{-19} coulomb, while the remainder of the atom carries the positive charge. The porter of a positive charge in the case of hydrogen is therefore about 700 times as massive as a porter of the negative charge. On this view, electrification of a substance consists in detaching free chips from the atoms of that substance. In electrolytic solutions it is only necessary that the chips should move, carrying their charges with them, and motion of the atoms themselves is not necessary, the chips being the vehicles by which electricity is carried from one atom to another. Prof. Thomson considers that the number of corpuscles which can be detached from an atom of an elementary substance by existing known means is limited to the valency of the substance, and that this number is, for example, one, in the case of hydrogen. Electrification therefore results in the detachment from an atom of hydrogen of a single chip or negative, ion and any attempt to increase the electrification results in the detachment of a similar chip from more atoms, and not of more chips from the same atom, because it is to be expected that it becomes harder to detach a second negative chip from an atom already rendered positive by the first detachment, and still harder to detach a third. It would also seem from experimental observations on the Zeeman effect that there is no lack of chips to be detached in an atom, but lack of forces wherewith to continue detaching them from the same atom.

According to this theory, the origin of frictional electricity, which is always so difficult to explain, seems to be satisfactorily accounted for, because the atoms of one substance are rubbed against the atoms of another, with the result that chips may be rubbed off the one and carried away by the other. The former become positively, and the latter negatively, electrified. This hypothesis is not alluded to in the paper, so we only offer it diffidently. No doubt many consequences will be found to flow from the theory if it once takes deep root in experimental verification. The principal idea is that a definite group of corpuscles produces a non-electrified atom, and that the destruction of this fabric by the removal of a corpuscle immediately leaves the fabric positively, and the corpuscle negatively, electrified. This is a sort of reversion to the Franklinic doctrine of electrical fluids that cannot fail to interest the student. It is also interesting to contemplate a Crookes tube as a protyle factory, but the process of manufacture must be so slow that concrete protyle does not seem yet attainable.

Metropolitan in Control of Third Avenue Railway, New York.

On Monday of this week the announcement was made that the Metropolitan Street Railroad Company of New York had secured control of the Third Avenue Railroad Company and its subsidiary lines, which properties are now in the hands of a receiver. The Metropolitan Company therefore now controls every foot of surface railway on Manhattan Island in the annexed districts, which is a result that has been predicted in some quarters for a long time. The business of the receiver of the Third Avenue Railroad will be wound up as soon as possible and the Third Avenue system will be turned over to its new owners. An inkling of the news got into Wall Street in the last hour on Monday and those who had sold Third Avenue stock short made a mad rush to cover that sent up the price of the stock ten points in ten minutes. The stock was scarce and there is believed to be still a heavy short interest.

In a formal statement on the subject, President Vreeland of the Metropolitan Company said:

"A number of considerations induced me to make a thorough examination of the financial situation of the Third Avenue property and to recommend the action which has been taken. In the first place it was always true that the property was worth a great deal more worked in co-operation with the Metropolitan than in any other way. This consideration has been urged upon me by all sorts of people—our own people, the creditors of the Third Avenue Railroad Company and a great many of its stockholders. I would not, however, commit myself to it until I became satisfied that it was an advantageous thing for the stockholders of the Metropolitan Street Railroad Company. In the last few days—perhaps a week or two—I have been under more or less pressure from my own people to take the matter up seriously.

"A good many millions of the proposed expenditures of the Third Avenue Railroad Company can be saved by using the power and the plant of our company. I have made the figures with great care and accuracy and I have become satisfied that the investment which we have made in the stock is a good one for the company to make. Of course, it will require a thorough overhauling of the indebtedness so as to get the debts down to a sound, honest basis. Then, the property worked in conjunction with ours, will carry the interest on the debt and leave something substantial for the stock.

"Harmonious action between the stockholders and creditors with such backing and connections as the Metropolitan Street Railroad can give it," Mr. Vreeland said in conclusion, "would put the property, in my judgment, on its feet for all concerned."

The Metropolitan Street Railway Company by coming into possession of the Third Avenue Company adds to its track mileage 174.98 miles. The mileage of its own system, according to the latest information at hand, is 232.07 miles of track, added to which the 174.98 miles of the Third Avenue system makes a total of 407.05 miles.

Gas and Electricity.

A considerable portion of the presidential address before the recent annual meeting of the New England Association of Gas Engineers by Mr. Walter R. Addicks, chief engineers of the Boston, Bay State & Brookline Gas Companies, was devoted to electricity. As to the future relations of electricity and gas Mr. Addicks ventured to sketch a possibility as follows:

Imagine, he said, a vast area having the following apparatus arranged in parallel rows, multiplied indefinitely: Beginning at the left there is, first, a long line of 15,000 3000-hp gas engines, direct-connected to alternating-current dynamos; second, a long line of triple-expansion, vertical 3000-hp steam engines, which are also direct connected to alternating current dynamos; third, a long line of boilers fitted with automatic stokers; fourth, a long line of gas producers fitted with up-and-down air and steam supply; fifth, a long line of water gas apparatus of the Lowe type; sixth, a long line of inclined retort stacks; seventh, a line of coke ovens. Appropriate condensing and purifying plant and holder are readily conceived to care for the retorts, ovens and water gas apparatus.

To the query, What could we do with such a plant? the following answer is given: A. The gas engines would supplement the steam engines by using their producer gas, poor-running-coke-oven-gas, or illuminating gas, depending upon the demands made on these products or the desire of the management. B. The steam engines would turn the steam from any boilers in use into a.c. electricity. This power could be of any desirable voltage, and be used for all the railways and electric lighting companies of the community, using step-down transformers, constant current transformers, rotary transformers, etc., depending upon the work required. C. The boilers could be fired with coal or coke, by stokers or by automatic stokers, or by means of the producers opposite, or by means of the gas from the coke ovens when producing beyond needs for other useful purposes. D. The producers could supply the boilers with heat as stated, but they could also supply the gas engines with producer gas as well as the coke ovens with heat. And also blue gas could be made for the Wilkinson process. E. The water gas apparatus would supplement the coal gas apparatus and allow the retorts and ovens to run at constant and uniform rate independent of gas demands. F. The inclined retorts would produce a steady supply of illuminating gas. We would here use the least weights of coal for the greatest number of feet of gas. The coke would be used when suitable for the demands of the community, any surplus to be used in the station—under the boilers for instance. G. The coke ovens would supply partly the illuminating gas demands, and perhaps gas to factories adjoining, for tempering and furnace requirements when exact ranges of temperatures are essential. The producers would care for the oven demand. Metallurgical coke or other grades could be produced at will.

Mr. Addicks asked the members to turn over the possibility outlined in their own minds, if only to satisfy themselves that this is no time to be pessimistic as to the future of their profession. He added that the gas business of the future will be conducted by men who shall combine knowledge of engineering—civil, mechanical and electrical—and of metallurgy and chemistry, with business experience in their profession such as members are obtaining from day to day and year to year.

Referring to electric lighting stations, Mr. Addicks said that to those members who have electric lighting stations, the modernizing of their plants is an interesting study. Study of the subject convinces him that compound and triple expansion engines, direct-connected to alternating current dynamos, are to be used exclusively for such stations. If the alternating enclosed arc can be successfully and satisfactorily employed on an extensive scale by the use of constant current transformers, the main supply lines can be kept at a minimum. A 500-volt power circuit can care for the elevator and power and railway service by means of rotary transformers. Keeping the power and lighting on separate circuits has its advantages. The lighting circuits being more likely to fail, the consumer has gas to fall back upon. The following figures were suggested as probable efficiencies deduced from a consideration of the subject:

	Efficiency from throttle to switchboard at maximum load may reach
Station having compound engines with belt driven jack shafts driving alternate and direct current dynamos for both arcs and 500-volt power.....	75 per cent.
Station having compound engines direct-connected to alternating machines; alternating current arcs and rotary transformers for 500-volt power current....	88.6 per cent.
Same, except with alternating motor driven, direct current arcs.....	85 per cent.

The unaccounted-for current in electrical circuits was stated to be as important a subject for observation as the unobserved gas unaccounted for. It is not alone necessary to have a perfect station service, but the process of "scrapping" electric machinery and buying better has an appreciable effect on gas competition. One is led to believe, he said, when first attempting to run both plants—illuminating gas and electric light—that they are in competition. They are, but the demand for electricity is entirely independent of its cost and must be met. The best result obtainable is, therefore, essential to keep up with the times. The Wright discount meter is destined, it would seem, to increase in use as time goes by. Gas engines for producing power for electric stations is a subject, he said, that will repay attention. He would not confine investigation to illuminating gas, but include the utilization of blue gas and producer gas and a mixture of the two. Mr. Addicks said he believes the day is coming when the electric light company will find the gas engine a factor in the competition for the business of supplying electric light to large office buildings and department stores.

American Types of Automobiles—IX.

THE AUTOMOBILE PRACTICE OF THE RIKER ELECTRIC VEHICLE COMPANY *

THE factory of the Lewis & Fowler Car Company at Elizabethport, N. J., has passed into the hands of the Riker Electric Vehicle Company, and under their management has become the manufacturing plant of one of the largest automobile industries in the country. The works are very extensive and contain every facility necessary for the production of electric vehicles, and the new machinery which has been installed has enabled the manufacture of every part of an electric vehicle except the storage battery, and this, too, will shortly be made there also. When this is done the Riker factory will perhaps be the only automobile plant in the country which manufactures every part of its output.

An electric automobile consists of a motor, a controller, a storage battery, a running gear and a vehicle body. There might be nothing new in any of these component factors, but "brains must be mixed with the paint" to combine them in a result which shall be substantial and practical. The Riker Electric Vehicle Company have been unusually successful in producing electric vehicles, and as they have been able to manufacture heavier and more powerful electrical vehicles than any heretofore known, a description of their engineering methods will doubtless be welcomed by those interested in the art.

The foundation of a vehicle is its running gear, and in the Riker production it consists of a rectangular frame of steel tubing firmly brazed together. An illustration of a typical gear is shown in Fig. 1, and on examination it will be noted that the tubular frame is secured to the rear axle at its corners by bearings. This makes a flexible device which allows the wheels to conform to various irregularities in the roadbed and serves to maintain a constant wheel base. The forward axle is stationary and is provided with internal pivoted hubs, as will be noted in the figure. In this device the pivot of the hub is in its very centre, and the pivot prolonged will pass exactly through the point of tangency of the wheel and the ground. The details of the pivoted hub are shown in Fig. 2. A hollow cylinder is secured to the axle by a ball-bearing pivot at right angles to the cylindrical surface. An arm projects from the cylinder whereby it can be moved on its pivot. The pivot is substantially secured by a bolt passing entirely through the cylinder and the axle end, and the ball bearings provided are adjustable so that any wear may be taken up and two

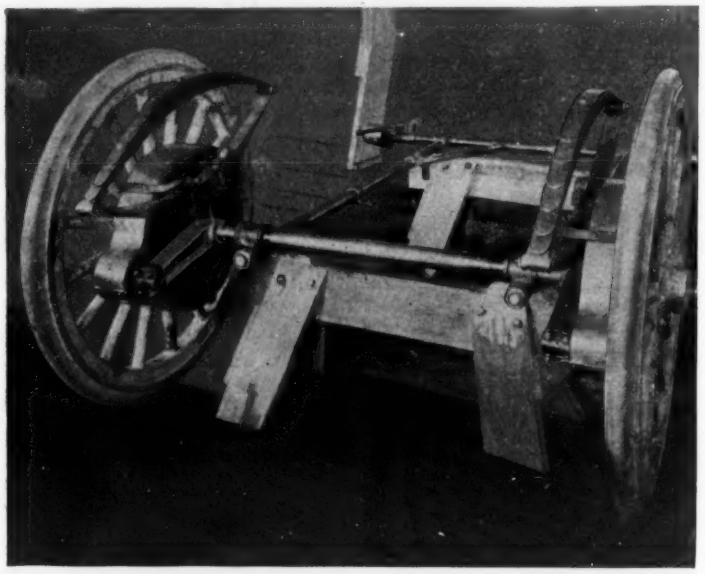


FIG. 1.—RUNNING GEAR OF DELIVERY WAGON.

suitable nuts securely lock the pivot from jarring loose. On the outer surfaces of the cylinder are mounted two steel runways for balls upon which the outer hub rotates. The interior mechanism is readily accessible by simply unscrewing the end plate of the hub, as shown in the figure. Although this device makes the hub somewhat larger than it would otherwise be, it is used on all of the Riker vehicles, even the heaviest. This makes the vehicle steer very easily and removes completely any tendency of the wheels to actuate the steering levers. It eliminates also to a great degree jarring on the steering handle, which is a very annoying factor in the manipulation of an automobile, and in some cases is very distressing.

The rear axle in the picture shown is solid and stationary, and upon it revolve the large wheels and the gears to which they are attached. The gear wheel is heavily strapped to the spokes of the vehicle by U-shaped straps, no dependence being placed upon keys of any kind. The gears are the external type and are provided with a sheet metal housing, the pinion and gear being kept in mesh by reason of the motor being clasped to the rear axle by appropriate clamps. This casting also carries a projection to which the elliptic spring which supports the body is bolted. The practice in spring sus-

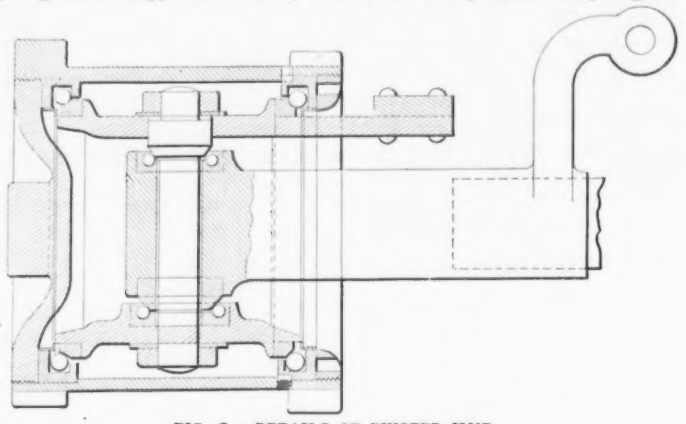


FIG. 2.—DETAILS OF PIVOTED HUB.

pension of the majority of the Riker vehicles is the use of longitudinal ellipitics in the rear and a reversed elliptic in the front of the vehicle.

It will be noted from the cut that the casing for the gears is quite wide, and this is due to the fact that within each case there is a powerful band brake acting directly on the extended rim of the gear. In this connection it is well to call attention to the fact that in all of the Riker vehicles the brake is either on the wheel itself or on some hub which is rigidly attached thereto. This seems undoubtedly a safer brake than any which could be placed on the motor axle because it will operate, no matter if pinion and gear be both stripped of their teeth or if in any other way the driving mechanism should fail.

The wheels of the vehicles are mostly of wood and the tires of solid rubber bound in by endless wires. This is undoubtedly the most substantial construction which can be used. It permits of the vehicle being washed with ease; it is more resilient than a wire wheel, and though the hard rubber tire is not as luxurious as the pneumatic, it will wear much longer. A pneumatic tire on a wheel which is powerfully motor driven is certain to have a short life.

The Riker vehicles use the two-motor system on all of their heavier types, but on the light pleasure wagons a single motor is sometimes used. The running gear details are largely the same, but the rear axle must of course be provided with compensating gears to enable the vehicle to turn corners. As is well known, this device very fre-

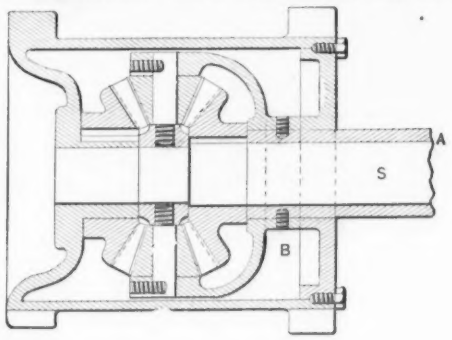


FIG. 3.—DETAILS OF HUB SHOWING COMPENSATING GEAR.

quently necessitates cutting the rear axle in two parts and holding the parts rigidly in line by a suitable frame. In the Riker vehicle, however, the compensating gears are placed in one of the rear hubs, thereby enabling the use of a continuous axle from hub to hub, making a very much stronger vehicle. Fig. 3 shows a section of a hub containing compensating gears. The hub is driven directly by the sleeve *A*. The frame *B* carries the bevel pinions and is fast to the hub. Within the sleeve *A* is the shaft *S*, which is keyed fast to one of the gears meshing with the small pinions. The other bevel gear is keyed to the hub. The result is that the sleeve *A* and the shaft *S*,

*For illustrations, Figs. 13 to 20, see supplement.

each of which carries a wheel, are free to turn separately and at different speeds though driven by the same motor. On a single motor vehicle the band brake acts on a large hub in the centre of the axle and is very powerful. Fig. 4 illustrates the arrangement of a single motor Riker equipment. The motor is pivoted on the axle and driven by means of spur gear and pinion which is contained in the casing. In the same casing is also contained the band brake previously mentioned. The axle consists of a sleeve and a shaft within it, which

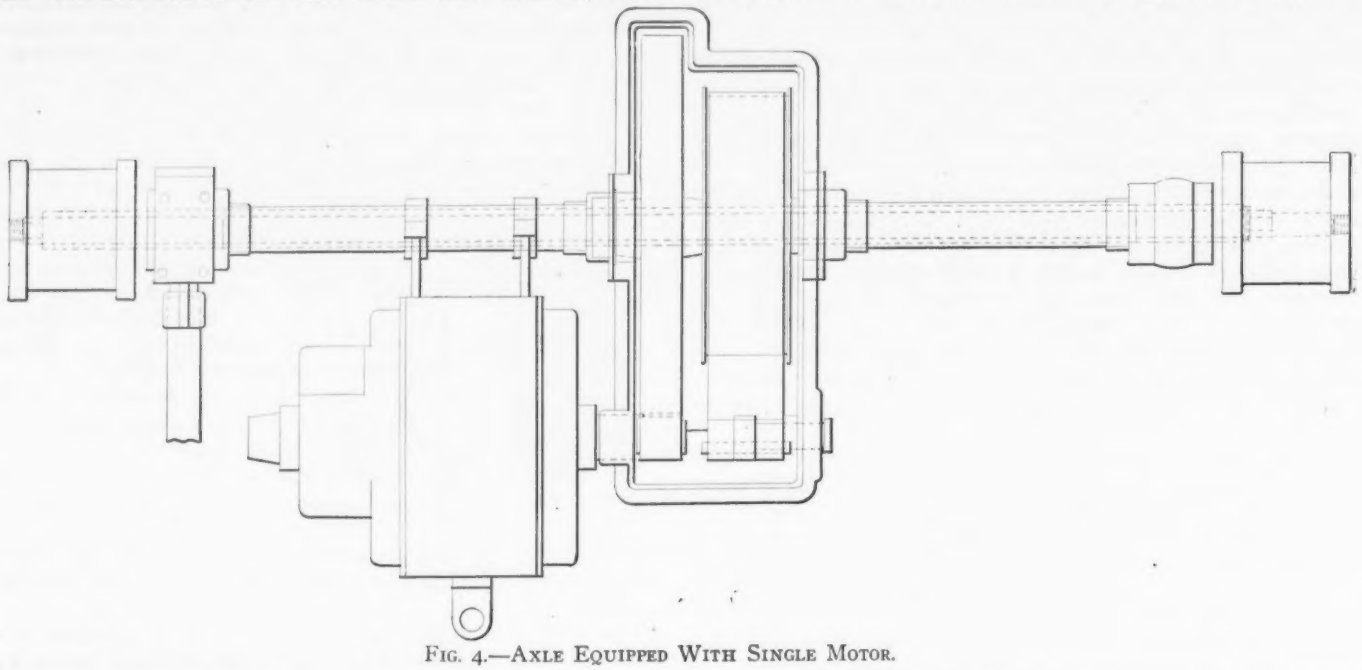


FIG. 4.—AXLE EQUIPPED WITH SINGLE MOTOR.

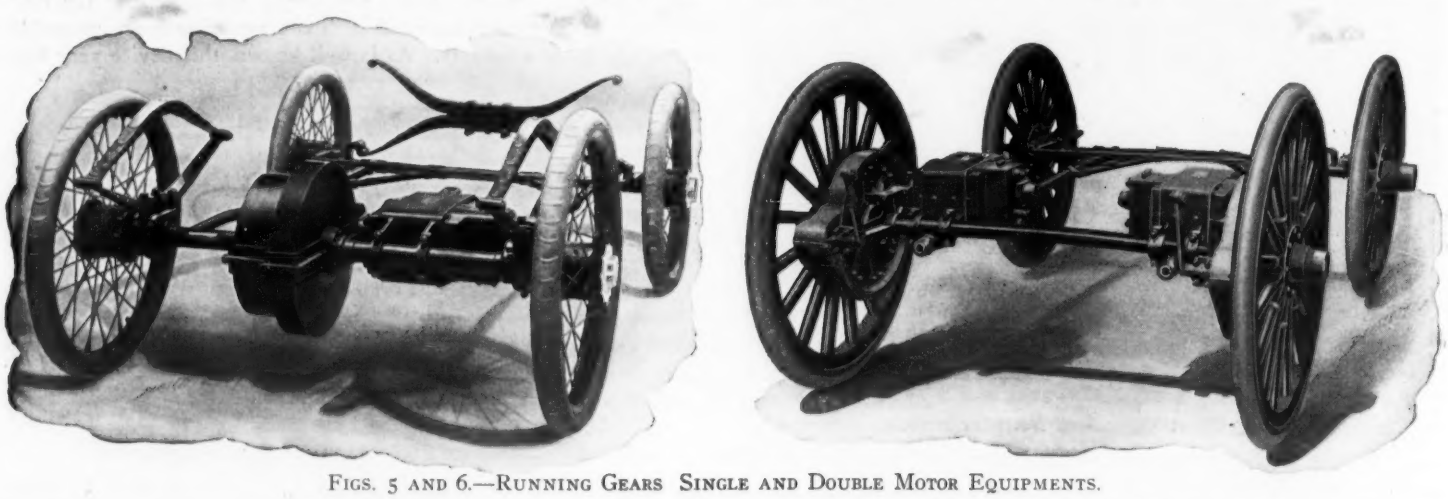
are connected together by compensating gears in one of the hubs. The dotted lines in the diagram show the sleeve and shaft construction referred to. On all the Riker vehicles there are installed three distinct methods of stopping. First, the reversal of the motors; second, the regular band brake, and third, an emergency brake which acts on the rim of the wheels. Figs. 5 and 6 illustrate respectively a single and double motor equipment and running gear which are typical of Riker methods. They serve to illustrate the principles which have been laid down in the foregoing paragraphs and are good examples of Riker practice.

The axles on all the Riker vehicles using two motors are given a "set" so as to render the centre line of the wheels at a slight angle with the perpendicular, the tread as measured between the tops of the wheels being noticeably longer than that measured at the bottom. This is done partly for the purpose of looks and partly for strength. If the wheel lines were perfectly vertical they would appear slanted toward the vehicle body, and, moreover, any heavy strains on the axle would tend to make them actually do this. The set given to the axles largely diminishes any tendency of an overload to spring the tops of the wheels inward and it makes the lines of the vehicle more graceful.

The motors used on the Riker vehicles were designed by Mr. Andrew L. Riker, and are very interesting. From Fig. 7 it will be seen that they are of the consequent pole type, and their flat rectangular shape lends itself very well to an unobtrusive location in cramped quarters, for which purpose they are mounted with the long dimension horizontal. The armature is worthy of special mention. It is, of course, of the toothed type, and the notches for the teeth are very deep. Fullest advantage has been taken of the fact that automobile motor service is temporary, and a much larger volume of copper is wound on the armature than would be used in cases where the load was of a continuous character. This enables the motor to exert an enormous torque, and combined with the powerful field makes the strength of the motor in this respect so great that it will not be denied. In consequence of this most Riker vehicles which are geared for moderate speeds would skid their wheels even to the extent of tearing the tires to pieces if the vehicle were rigidly blocked and full power turned on. This powerful torque is an exceedingly desirable feature, for it minimizes the possibility of the vehicle becoming stalled on grades or in soft spots in the roadway.

Some details of the armature are shown in Figs. 8, 9 and 10, and are worthy of a few words of comment. The armatures have four poles and are series wound, and therefore can receive their current from two brushes on the quarter. The coils are separately formed and the leads are brought out directly from the slots in the following way: the under set of leads is brought out straight to the commutator and the upper set advances nearly 90 degrees, thereby connecting the two terminals of a coil to nearly opposite bars on the commutator. This arrangement permits of the installation of the brushes between the pole tips, which is a desirable and convenient position, and also permits of the removal of a coil without unsoldering half of the commutator bars. It is only necessary to unsolder one-quarter of the bars and also the upper lead of the coil to be removed. This very much simplifies armature repair in case that should become necessary.

The winding of the armature is on the straight out plan, as the fig-



FIGS. 5 AND 6.—RUNNING GEARS SINGLE AND DOUBLE MOTOR EQUIPMENTS.

ure shows, the sharp bend at the change of plane is very much less abrupt, due to the peculiar method of winding the coils. Inasmuch as faulty insulation and incipient cracks in the wire are often harbored at sharp bends at this location, this method of avoiding them becomes an important feature. The shape of the coils is depicted to better advantage in Fig. 9, where one of them is shown as it appears ready for use. The slots in the armature are from six to eight wires deep, according to type, and only one wire wide.

The motor is, of course, of the series type. The outer frame is of steel, as is also the magnet waist and pole pieces. The coils are mounted on the pole and the pole pieces hold them in place in the usual way. Brass or non-magnetic end plates carry the bearings, enclose the commutator and make the motor moisture and dust proof.

A particular feature of the Riker automobile construction is the motor suspension. This is exceedingly simple, and in the double motor system consists of bolting the motor rigidly to the axle and running gear. In some cases the motor hangs from the running gear and in other cases it rests upon it, but in any case it rides rigidly. It has been very hard indeed for automobile makers to break away from electric railway practice in this respect. They seem to have forgotten entirely that their motors no longer weigh 1500 to 2000 pounds each, that they no longer have any rail joints to preserve from pounding, and in consequence many vehicles are seen in which the motor is spring suspended and pivoted on the axle, involving a multiplicity of nuts, bolts and springs, which Mr. Riker avoids by the rigid mounting. The motor is so small that it can ride rigidly as secure from damage to itself or any other part of the vehicle as if it were a bolt or nut on the running gear.

The controller which is used by the Riker Electric Vehicle Company is most substantially made. The commutating segments are of solid castings which are mounted rigidly on an axle. The combinations vary with different vehicles, but in general it may be said that the different speeds are obtained by commutating the battery, and in all cases without the use of any regulating resistance. The controller which is shown in Fig. 11 is of the single lever type, there being no separate reverse lever. In the vertical position the handle is at "off" and ordinarily is locked there. A backward motion of the handle gives a backward motion of the vehicle, there usually being two backward speeds. A forward motion of the handle sends the vehicle in a forward direction and there are from three to six forward speeds, according to type. The controller cylinder makes a complete revolution, but the handle swings through only a very small arc. This is accomplished by connecting the handle with the controller spindle by means of a pinion and toothed sector. A latch is provided to lock the controller at the "off" position and can be released by pressing the button at the end of the handle. This

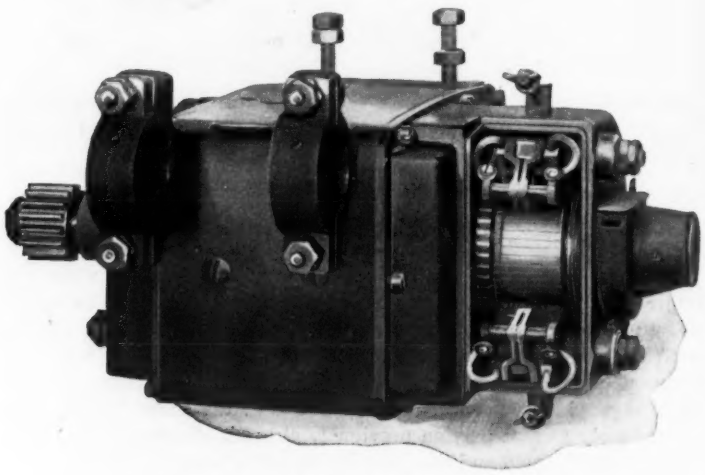


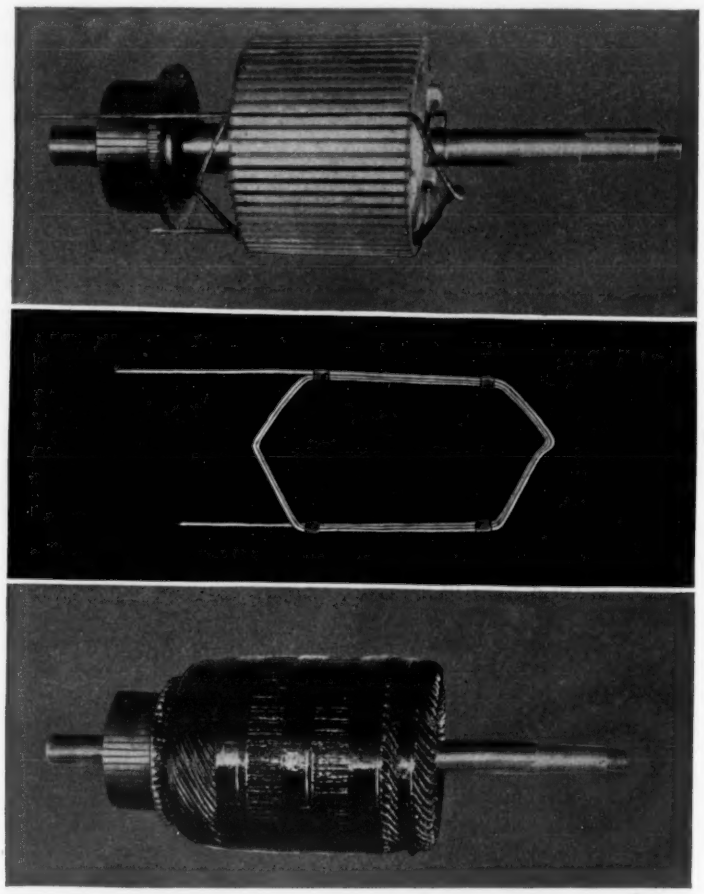
FIG. 7.—GENERAL VIEW OF MOTOR.

prevents overtravel of the handle from either the reverse or the forward sections of the controller which, if permitted, might cause inconvenience or even danger. The motors are not commutated in any of the Riker methods of control. They are either always in series or always in multiple.

The Riker Electric Vehicle Company have been using the various standard storage batteries in their vehicles, but are about to make their own cells. These will be constructed with very light positives and negatives and arranged for easy renewals, the idea being to make the renewals within a reasonable time and to have the renewals inexpensive and easily made. This insures a very light battery and one which will always be in good order. The batteries are stored in long crates of various shapes and the company is entitled to particular credit for the ingenious way in which they have disposed and secreted the batteries about the vehicle. In some cases the location of this popularly dreaded bulky accessory has to actually be sought for. For instance, in the vehicle shown in Fig. 14, a delivery wagon for pastry, the batteries are cunningly stowed away in long narrow compartments immediately beneath the cupboards of the wagon and on each side of the vehicle. The arrangement therefore permits of full head room from top to bottom.

On another wagon, illustrated in Fig. 15, a portion of the battery is installed under the seat and the other part is underslung, the arrangement being very inconspicuous, but nevertheless very secure and permitting of full head room in the rear. The batteries are connected to flexible cables with hook terminals by suitable binding screws on the sides of the crates. They may be charged either inside the vehicle or without, as in every case ample provision is made for the escape of fumes while charging. For the purpose of charging, each vehicle is fitted with a charging plug, shown in Fig. 12. This is a standard type of plug which has been adopted by other companies, and its character and workmanship is such that it will probably become as well known to the vehicle industry as the Edison socket is in the lighting field. The Riker vehicles are each provided with an emergency switch which breaks the motor circuit, a fuse box and a voltampere meter; and in addtion the control is so arranged as to prevent the simultaneous application of the power and the brake.

In the field of heavy vehicles the Riker Electric Vehicle Company have probably produced the heaviest yet made. Typical of their



FIGS. 8, 9 AND 10.—DETAILS OF ARMATURE.

work in this direction is the large truck illustrated in Fig. 18. This is in all respects of engineering practice similar to other Riker vehicles, but its dimensions and capacity are interesting and are as follows: Wheel base, 100"; tread, 76"; weight of battery, 2600; power of motors, 10-hp each; maximum speed on level, 5 miles an hour; weight of truck complete, 4.4 tons; carrying capacity, 4-5 tons; working radius, 20 miles. The steering of this vehicle is accomplished by a powerful hand wheel and train of gears which actuates the spindle moving the lever system below. The forward hubs

are of the internal pivot type. The wheels are of wood and the tires are solid rubber. The brake is very powerful and consists of two heavy bands, one on each wheel.

An interesting incident of an utterly unpremeditated character occurred while the writer was at the works, in which this truck played a leading part. It is illustrated in Fig. 13. The company was making a large shipment of machinery amounting to some five or six tons loaded in a four-horse truck. This truck stuck fast in soft wet ashes at the entrance of the driveway at the Riker works, and the utmost efforts of the horses failed to move it. The heavy Riker truck happened to be conveniently at hand, and advancing to a suitable position, by the aid of a beam it pushed the horse-drawn truck into the street without the slightest apparent effort; and once on the hard pavement the horses could handle the load all right. The incident is worthy of comment, for no one thinks of the horse as being unreliable because he gets stalled on grades or falls down sick or injured in the streets, and yet this occurrence is very frequent. If an automobile, however, becomes stalled through any reason, the accident is unique, it attracts a crowd and becomes the foundation of a great deal of invidious criticism. Here at least is one case out of many where the automobile proved more efficient in an emergency than the horse.

The Riker Electric Vehicle Company have been very fortunate in securing the system of Mr. Andrew L. Riker for exploitation. He has been connected with this industry for some sixteen years and his vehicles have won a considerable reputation. An interesting collection of his historic evolutionary vehicle is shown in Fig. 20, some of which represent Mr. Riker's earlier experiments. The vehicle in the foreground is a production of some four years ago and has won numerous races in competition. Its appearance compares very favorably indeed with vehicles which are used to-day, and, in, fact, it is superior to those of many types. It is, however, now a part of history.

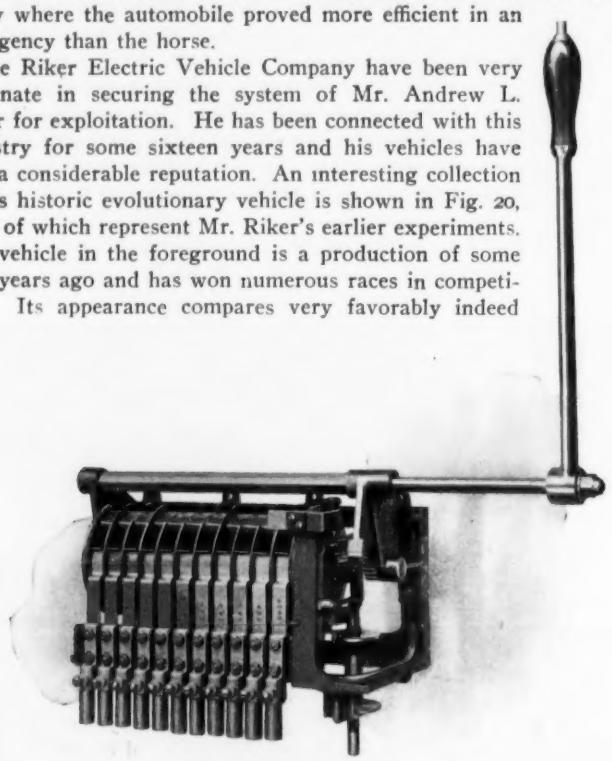


FIG. 11.—CONTROLLER.

The equipment of the works of the Riker Electric Vehicle Company is worth a word in closing. To describe them exhaustively in their present condition would be premature, for they are still undergoing extensive change to adapt them to their present purposes.

The wooden portion of the vehicle originates in a large lumber room where every foot which enters into vehicle construction is kiln dried. Next to this room is a carpenter shop in which the lumber is sawn, planed and sand-papered into suitable shape for convenient use as stock in the wood-working department which is immediately adjacent. In this room the wood is formed into bodies of scores of different varieties, and the department is at present very full of work. The completed wooden body passes to another department where it is given its preliminary coats of heavy paint and lead, and then to still another department where it is "ironed." Here the productions of several departments come together. From the machine shop via the winding rooms come the completed motors ready for fitting. From the machine shop directly come the gears, pinions, nuts, bolts, steering levers and various other necessary accessories on which machine tool work is required. In the department where the vehicles are "ironed" the running gear frames are also constructed, ample facilities being provided for that purpose. The vehicles leave this department ready for the paint shop. The iron work on a vehicle is of such an intricate character that it requires a great deal of hand work, and consequently this department is provided with a number of forges. The arrangement of these forges is very interesting. There are two sources of draught provided, one an ordinary centrifugal blower which acts as a blast on the fire from beneath, and the other an exhaust fan which draws off the products of combustion through a hood and thence downward through a pipe under the floor and up through a chimney. The result is that the shop is always free from smoke and soot. The operating parts of the vehicle are practically completed in this department, and after having such preliminary tests as are thought to be advisable, the vehicle is moved up stairs on an electric elevator to the finishing room.

The company has provided an elaborate varnishing room painted in light yellow and amply provided with dust screens and everything necessary to the elaborate decoration of the vehicle. Indeed the work which is being turned out from each department shows that the facilities and the labor are of the best.

The drafting room in which the work is designed is well equipped for its purpose. It is provided with large blackboards on which the vehicles are drawn full size, for in no other way can the proportion of the parts and the general symmetry be better determined.

The factory is two stories high and includes in its upper story a large winding room, drafting room, stock room, numerous storage departments and the varnish rooms. The machine shop is well equipped with everything for rapid production. The gears are cut by automatic machinery. A department of the machine shop is set apart for the care of tools and a corps of men and equipment of machine tools is provided there for keeping the tools required by the entire shop in repair. No time is consumed in sharpening and adjusting tools by the main body of workmen.

A thorough system has been established in the operation of this shop whereby accurate and easily inspected accounts are kept of the time of the workmen, the nature of the work, tools and material used. The result is that the Riker Electric Vehicle Company are gaining an accurate idea of the exact cost of manufacturing their vehicles, and it can only be said that this figure necessarily becomes less and less with the new methods of construction which they are developing daily.

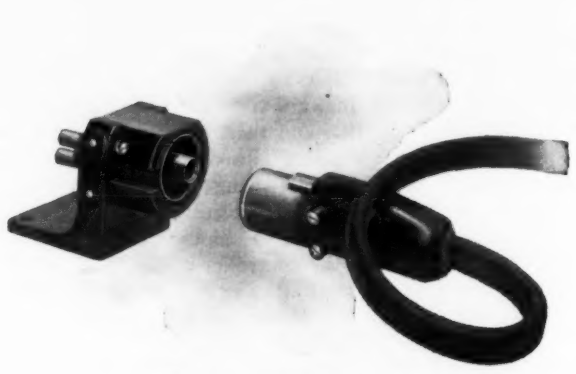


FIG. 12.—CHARGING PLUG.

Montreal Snowed Under.

Montreal was visited March 1 and 2 by a snowstorm of a severity unprecedented in the memory of the oldest inhabitants. The fall of snow registered no less than four feet five inches and this, combined with the high wind prevailing soon rendered the street well-nigh impassable. The many sweepers of the street railway company were early at work, but progress was slow due to the snow drifting back immediately to that portion previously cleared. Soon only one main line remained open, and that only by strenuous exertions. The work of digging out the various lines had already begun before the storm subsided, and by Saturday morning all the city lines were in full operation, with the outskirts well under way. The city is divided into forty-four sections with 45 men per section, totaling 1980 men and 1120 box sleighs for the removal of the snow. The city is a sight to behold—snow banks on either side of every street extending well up to the second story of the adjoining houses, while in the avenue between sleighs and street cars ply unseen by pedestrians on the sidewalks. The loss to the street railway is estimated at $28,000, due to decreased earnings, injury to equipment and cost of removal of snow—this last item is only half the acutal cost, as the city pays the remaining half.

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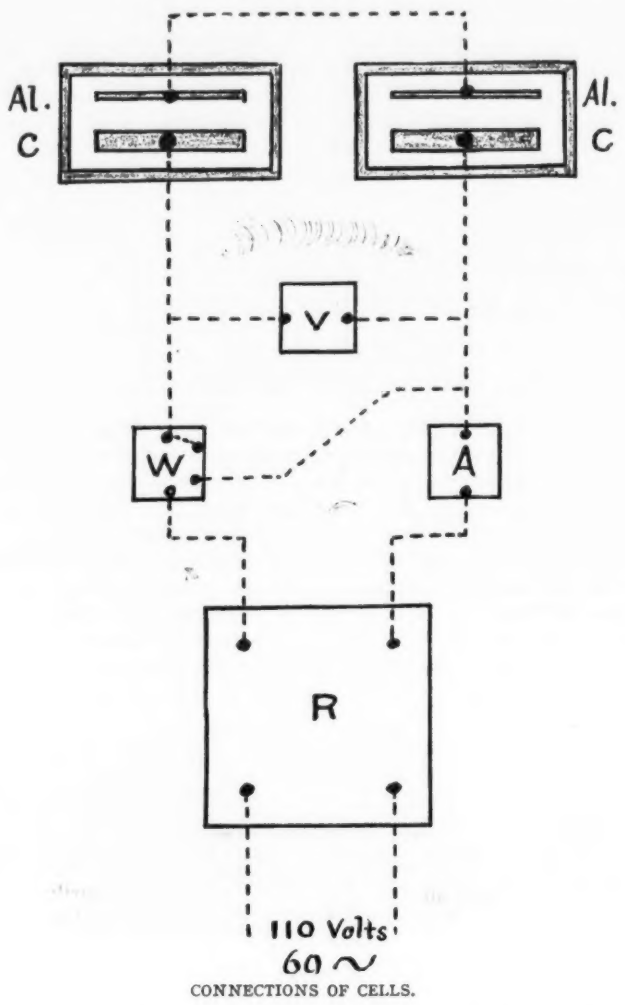
The Luminescence of Aluminum Electrodes.

BY W. S. ANDREWS.

WHILE experimenting with two aluminum-carbon cells, I noticed a curious luminescence of the aluminum plates, which led to further investigation, a brief account of which may interest some of your readers.

The immersed surface of each plate was 4½" x 4" (one side) and the cells were charged with a saturated solution of Rochelle salts (double tartrate of potash and soda). Two cells were connected in opposition to each other, the aluminum plates being connected together, and the leading wires being attached to the carbon plates. (See sketch.)

The frequency of the alternating current used was 60 cycles, and the voltage could be varied by a regulating transformer. A voltmeter, ammeter and wattmeter were connected as shown in the accompanying sketch, in which Al are aluminum plates; C, carbon plates; V, voltmeter; W, wattmeter; A, ammeter, and R a regulating rheostat. With this arrangement the following readings were taken:



CONNECTIONS OF CELLS.

Volts.	Amperes.	Watts.
90	.25	5
110	.25	10
120	.3	13
130	.35	15
140	.4	20
150	.5	25
155	.7	70
160	1.4	150
165	2.0	240

At about 90 volts the submerged portion of the aluminum plates became faintly luminous. At about 120 volts a number of little stars appeared on the luminous surface, which was now much brighter, and these stars increased in number and brilliancy as the voltage was raised. At about 150 volts a singing noise was audible, probably due to the rapid formation of bubbles on the surface of the aluminum. All the above phenomena increased in intensity up to 165 volts, when the liquid became so turbid with bubbles that the surface of the plates was hidden, and the voltage was not pushed any higher.

The stars and luminescence were not entirely confined to the immersed portion of the plates, but extended above the surface of the liquid as far as the salts had crept up the plates. Providing the cells are connected in opposition to each other, it is unimportant whether the aluminum or the carbon plates are on the outside.

The voltages as above given are only correct in connection with the series of phenomena described, under conditions which obtained at the time of observation, which was about 48 hours after the cells had been charged. With newly charged cells, the luminescence and stars will appear at a much lower voltage, and the leakage of current through the cells will also be greater. Under this condition the current should be started at about 5 volts and gradually increased. If a much higher voltage is used at the start, the rush of current will almost amount to a short circuit, but after the cells have been in use for several hours, the starting voltage may be as high as 50 volts.

The apparent high resistance of these cells to an alternating current may be due to the formation of a non-conducting film of oxide on the surface of the aluminum when the latter is an anode, and as each of the aluminum plates becomes an anode in its turn as the current alternates, the resistance is continuous.

The luminescence which appears long before any stars are seen may be caused by a large number of very small stars that are individually too minute for the eye to distinguish (like the stars in the "milky way") and the phenomena may be traceable to the "electric forge" effect, which also finds a unique application in the Wehnelt current interrupter.

A Wehnelt interrupter can easily be made with these cells by touching one end of a piece of small copper wire to one of the aluminum plates and immersing the other end in the liquid. This experiment should, however, be performed very carefully, for if one cell is short-circuited from aluminum to carbon by a copper wire, the other cell will only hold back the current in one direction, so that the current in the other direction will be practically short circuited through the copper wire.

The Regulation of Storage Battery Voltage.

BY RODERICK MACRAE.

ONE of the most serious objections to the use of lead storage batteries for certain classes of work arises from the fact that the voltage of the battery varies with the state of charge of the battery, and varies also with the rate at which it is receiving, or giving out, energy.

Although the types of battery now on the market are, it is safe to say, a long way short of what they might be, yet granted that we have the best battery that can be made out of lead, it will still require 2.4 volts per cell to charge it fully, and if discharged at the rate of about one ampere per pound, the voltage will drop to 1.7 before the battery is practically empty. The above figures will vary somewhat according to the particular construction of the battery, such as thickness of plates, etc., but roughly speaking, a difference of 30 per cent. to 40 per cent. will always exist between the voltage of a lead battery charging when nearly fully charged and its voltage when discharging and nearly empty. It follows therefore that in order to get all the work out of a storage battery that it is capable of doing, it will be necessary to have a voltage of 2.4 volts per cell available for charging, and a discharging circuit on which 1.7 volts per cell can be used to advantage.

For certain classes of work a considerable variation in the voltage of the source of current does not involve any serious inconvenience. The difference between the voltage of a primary battery when newly set up to operate a telegraph circuit and its voltage when cut out of service in order to be cleaned is often as great as 40 per cent. So also when a storage battery is charged in one place and discharged in another, as happens when it is used for automobile work and the like, the variation in voltage is practically of little consequence. If we consider the variation of voltage of a lead battery during discharge only, it will not be found to exceed at the outside 10 per cent. This amount is negligible for practical applications of this kind.

When, however, the question of using storage batteries on light and power mains for the purpose of regulating the pressure and alternately giving and taking energy from these mains has to be considered, then the difficulty heretofore experienced in regulating

the voltage of the batteries themselves constitutes one of the greatest objections to their employment.

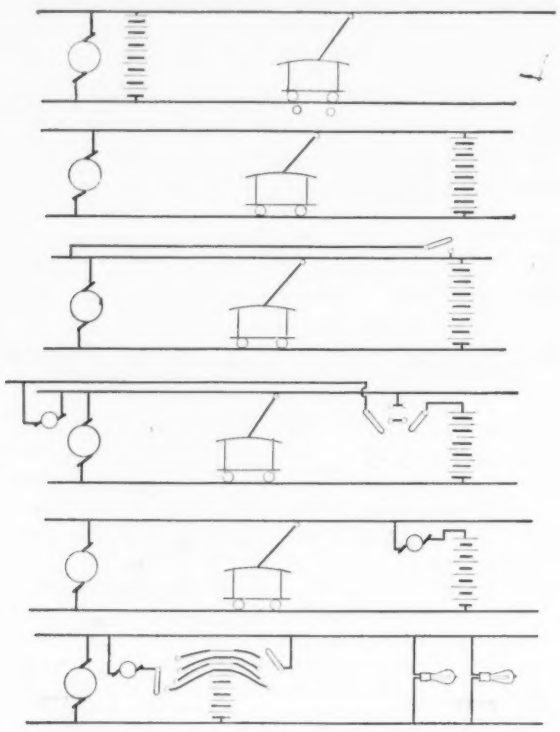
That a storage battery will, under certain circumstances, work in a most satisfactory manner on light and power mains, has been pretty conclusively established, and for any given conditions it is a simple matter, when the capacities and limitations of the different factors are known to make such a combination of generating and battery apparatus as will allow each of them to be operated under conditions of nearly maximum efficiency. But in actual practice, however, the conditions are never given. On the contrary, the conditions and load curve are subject to the most abrupt changes without notice, and present methods of operating batteries do not afford the flexibility necessary to enable them to be used to the best advantage under such circumstances.

Some of the methods now employed in operating storage batteries on distributing mains are shown in the accompanying diagrams:

Fig. 1 represents a battery in parallel with the generator on a street railway circuit, the battery being located in the power house.

In Fig. 2 the battery is connected up the same as in Fig. 1, but located at a point distant from the power house.

Fig. 3 is the same as Fig. 2, but with a special cable connecting the bus bar at the power house with the line at the point where the battery is connected to the line.



FIGS. 1 TO 6.—VARIOUS ARRANGEMENTS FOR OPERATING STORAGE BATTERIES.

Fig. 4 is the same as Fig. 3, except that the feeder is provided with switches that allow the battery to be disconnected from the line while charging through the feeder. The voltage of the current passing through the feeder is raised by means of a booster at the power house.

In Fig. 5 the battery is at a distance from the power house, with a motor booster in series with it. The fields of a booster are provided with a special switch by means of which their polarity can be reversed when desired.

In Fig. 6 the battery is located at the power house, with independent charging and discharging circuits. The bus voltage for charging is raised by passing current through a booster, and switches are provided that allow some of the cells to be cut in or out of either the charging or discharging circuits.

The difficulty experienced in operating a battery connected up as in Fig. 1 is due to the fact that with ordinary compounding generators there is not sufficient variation in the bus-bar voltage to allow the battery to charge or discharge. This is sometimes partially overcome by putting a shunt across the terminals of the series winding of the generator. This causes the bus-bar voltage to drop during times of heavy load and allows the battery to discharge into the circuit. The variations that can be obtained, or that it is desirable to produce, in this way are seldom sufficient to enable the battery to carry any appreciable part of the load, and in case the battery does get discharged during an emergency it takes too long a time to get it filled up again.

In a power house equipped with a battery connected up in this manner, a fire occurred not long since that necessitated the shutting down of the engines for nearly an hour during the time of heavy load. The battery carried the load satisfactorily until the engines were again started, discharging for most of the time at much above its rating. Next morning a broken steam pipe caused the shutting down of another power house connected by cables to the power house where the battery was located. The battery was called upon, but was found to be empty, and was, of course, quite useless.

The arrangement shown in Fig. 2 has the advantage over that in Fig. 1 in so far that ordinarily there is sufficient rise and fall in the voltage of the line at the point where the battery is located to allow it to charge and discharge without the necessity of arranging for periods of high and low voltage at the power house simply to accommodate the storage battery. It is sometimes possible to so adjust the number of cells in the battery to the average voltage of the line at the point where it is connected that for days, or perhaps even weeks, at a time the battery may work automatically. In case, however, of any departure from ordinary working conditions, the voltage at the battery is less under the control of the operator than

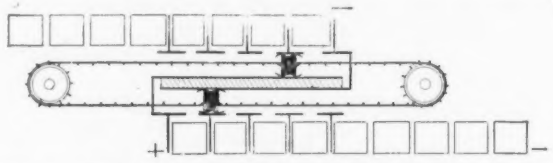


FIG. 7.—DIAGRAM OF CIRCUITS FOR BATTERY TELESCOPING.

it would be if the battery were located at the power house. The bus-bar voltage may be raised or lowered, but the effect it will have on the battery will depend entirely on what is taking place on the line between the battery and the power house, the result being unnecessary waste of current and injury to the battery.

With the arrangement shown in Fig. 3, the voltage at the battery can be raised by throwing in the special feeder leading from the station bus-bar. When it is desired to discharge the battery into the line, the voltage of the line at the battery is lowered by disconnecting the feeder. This arrangement, while affording only partial control of the battery, necessitates the putting of one part of the

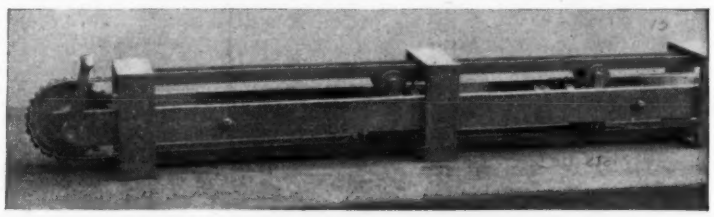


FIG. 8.—PORTION OF BATTERY TELESCOPING SWITCH.

equipment out of service in order to allow another part to come into service. This, too, happens sometimes at a time when the load on the power house and feeders is so heavy that some of the cars have to be taken off the route in order that the balance may be properly heated and run on schedule time.

With the system of battery connections shown in Fig. 4 the battery while disconnected from the line can be charged up quickly by means of the feeder. This is done during times of light load. The objection to this is that while the battery is charging the line is deprived of the benefit of the battery at a time when the momentary fluctuations of the voltage are the greatest; and as the amount of current that passes through the booster and over the feeder is nearly constant, the engines at the power house are also deprived of the regulating effect of the battery. It is this feature of the battery that is generally the most appreciated by the engineer at the power house, for while he may be indifferent to the rate at which the coal pile is disappearing, as being something inevitable, he is likely to be worried by the spasmodic motion of his engines after he has once found out what a battery can do in the way of steadying the load. Another difficulty is that when the battery is charged and put back on the circuit, it is liable to commence discharging into the line at a time when there is no occasion for it, and when an

emergency arises it is a matter of chance whether or not there is anything left in the battery. As helping out in an emergency is just the kind of work that a storage battery is well up to, an effort should be made to keep it at all times as far as practicable in readiness for that service.

With the arrangement shown in Fig 5, by reversing the polarity of the booster, the combined voltage of the battery and booster can be made greater than that of the line; or the combined voltage of the booster and line can be made greater than that of the battery. By this means the current can at any time flow either into or out of the battery as desired. The objection to this system lies chiefly in the low efficiency of the motor booster. Motor boosters suitable for this class of work seldom have at best an efficiency of over 50 per cent., and as they must be designed to carry the maximum current that the battery may be called upon to give, they are ordinarily operated at but a small fraction of their capacity. They also draw current from the mains during the peak of the load or during an emergency, and consequently at a time when the current is the most valuable. Instead, therefore, of being a storage battery plant, it is really a combination of battery and booster, where the advantages that might be obtained from the battery are in a great measure offset by the disadvantages of having to use a booster. But not only is this arrangement inefficient, it is also unreliable. The experience of one of the largest street railway companies now using such a system in having its booster armature burn out twice in the course of a few weeks, emphasizes the risk involved in depending on a battery when the operation of the battery is itself dependent upon the operation of a motor and a booster.

Fig. 6 shows the arrangement generally found in electric lighting stations where the maintenance of a nearly uniform voltage is of more importance than it is on power circuits. This method gives complete control of both charging and discharging voltages, and the battery while discharging is independent of any generating machinery. For small battery plants receiving careful attention, this arrangement is not open to any very serious objections, but when large batteries capable of discharging at the rate of five to ten thousand amperes have to be considered, the complications of the switching devices and the amount of copper necessary for conductors become simply appalling. No one with any knowledge of electricity can suppress a feeling of awe when he sees for the first time the massive switches and the forest of copper bars in the battery rooms of some of the larger Edison stations. If he is told that out of all that confusion of copper only one or two bars can be in service at the same time, and that many of the cells—although hardly ever discharged except on rare occasions, and then only for a few minutes at a time—have nevertheless to be partly charged every week in order to keep them in working condition, he is very liable to think that the storage battery art is quite far from being in a finished state.

The method of battery voltage regulation that we wish to draw especial attention to here is that shown in Fig. 7. This method consists in telescoping the battery by putting some of the cells in parallel with the others in order to lower the voltage of the battery and putting them again in series to raise the voltage. This is accomplished by making two contact shoes or brushes travel up and down between two rows of cells by means of an endless chain in the manner shown in the diagram. This arrangement overcomes either wholly, or, to a great extent, the most of the objections to the methods of connecting up batteries above mentioned.

None of the cells are at any time cut out of the circuit. When in series they add to the voltage of the battery, and when in parallel they reduce its internal resistance, thereby allowing the battery to operate with a smaller variation of voltage at its terminals. The cells that are discharged in series and charged in parallel will, of course, fall behind the rest of the battery and have to be charged up by means of a small motor-generator. This generator may be started or stopped at any time independently of what the battery may be doing and will ordinarily be stopped during periods of heavy load.

For certain classes of work it may not be necessary to start this generator for weeks at a time. This arrangement does away with the use of cumbersome and expensive end cell switches and conductors and obviates the necessity of wasting time and energy in charging cells simply to keep them in working condition. It gives entire control of the battery voltage and makes it possible to utilize the battery at all times efficiently and to the full extent of its capacity.

Fundamental Ideas of Alternating Currents.—II.

By Prof. Dugald C. Jackson.

(Concluded.)

ANOTHER set of analogies to illustrate electrical currents and show relations still more clearly, is as follows:

1. A continuous current is like the uniform current of water set in motion by means of a centrifugal pump operated at a constant speed. (Fig. 9.)

2. A pulsating current is like the current of water set in motion by a piston pump. As the piston moves forward in the water cylinder, the water therein is forced to flow through the delivery pipe; when the piston reaches the end of its stroke the flow slackens or ceases, and as the piston returns on the stroke the flow again proceeds, as before, through the delivery pipe and slackens as the piston reaches its initial position. (Fig. 10.) This is repeated as the stroke is repeated and the action causes a succession of impulses to the water with intervening pauses or slackening of the current.

3. An alternating current is like the current of water which would be set up in case the delivery and suction pipes of the piston pump were connected directly together and the valves removed. Now as the piston moves back and forth, the water flows unceasingly back and forth alternately from one end of the cylinder to the other as long as the pump is operated. (Fig. 11.)

Fig. 11 shows clearly that a complete cycle of flow is produced with each revolution of the pump driving shaft, that is, with each 300 degrees of angular motion of the shaft. We may, therefore, for the sake of convenience, divide the horizontal zero line or axis in our charts into 360 parts for each "period" of the flow, and call

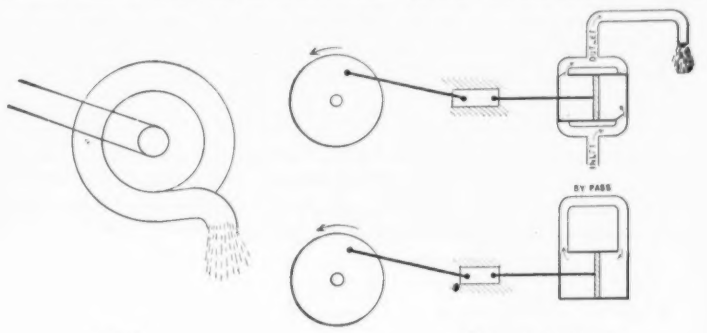


FIG. 9. FIGS. 10 AND 11.

the parts "degrees" instead of fractions of time. This is illustrated in Fig. 12, which shows two alternating currents of different phases. We may speak of these as having 30 degrees difference of phase, or they are 30 degrees apart, since they cross the horizontal axis at points which are 30 divisions or *degrees* apart.

The alternating curves which are shown in the figures are all smooth curves, but actual waves of alternating current and pressure are usually more or less irregular in outline, and sometimes they are very irregular; but successive loops are normally similar. Two alternating current curves, the outlines of which were determined by experimental means, are shown in Figs. 16 and 17.

It is also a fact that alternating current curves do not have the same shape as the waves of pressure which are applied to produce the currents, whenever any iron is magnetized by the current—which is almost always. The curve shown in Fig. 16 is the curve of current set up by a quite flat-topped, steep-sided pressure wave, while the curve of Fig. 17 was set up by a smooth pressure wave with a form quite like a sine wave. Changing the iron or other conditions of the circuit will produce changes in the forms of the current curves, though the pressure curves remain unchanged.

If a heavy block is suspended so that it is perfectly free to move, and then is struck a sharp blow, for an instant it offers a force which opposes the force of the blow almost as though the block were rigidly fastened. This opposing force is well known to be caused by the *inertia* of the block. Inertia sets up a force which tends to violently oppose any sudden change in the motion of a body, and when the suspended block is started swinging it may strike a considerable blow upon its own account when met by an obstacle.

When an electromotive force is introduced into an electric circuit the circuit by a kind of electromagnetic inertia opposes the immediate flow of the current (very much as the inertia of the sus-

pended block opposes the force of a blow before the block moves), and the rise of the current in the circuit is retarded. If the circuit is severed or broken while current is flowing, the electromagnetic inertia makes an effort to uphold the current (as the swinging block is difficult to stop), and an electric spark appears as its evidence in the gap between the severed ends of the wire.

Faraday (whose name is almost a household word on account of his discoveries in natural philosophy, and especially in electricity and magnetism) was well acquainted with this retarding effect as early as 1835, and describes it in his "Experimental Researches." He says: "Returning to the phenomena in question, the first thought that arsises in the mind is that the electricity circulates with something like *momentum* or *inertia* in the wire, and that thus a long wire produces effects at the instant the current is stopped which a short wire cannot produce. Such an explanation is however, at once set aside by the fact that the same length of wire produces the effects in very different degrees, according as it is simply extended, or made into a helix, or forms the circuit of an electromagnet." He then shows that the apparent inertia is due to the magnetic effect of the current. For instance, he says: "Further investigation led me to perceive the inaccuracy of my first notions and ended in identifying these effects with the phenomena of induction which I had been fortunate enough to develop in the first series of the Experimental Researches."

Faraday further speaks of this as a ***retardation*** of the electric current in the circuit, and ascribes the effect to the "induction of the current on itself," or self-induction of the circuit. The phenomena of electromagnetic induction were studied about 1850 (fifteen years after Faraday's experiments) by Sir William Thomson (now Lord Kelvin), Helmholtz and other scientists, who brought to their aid the powerful resources of mathematics, and their work was canvassed and discussed by Maxwell in his book on "Electricity and Magnetism," who shows that the effect of self-induction is truly the result of *electromagnetic momentum or inertia.*

FIG. 12.

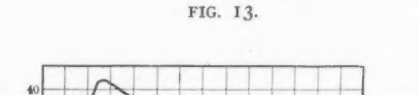


FIG. 13.

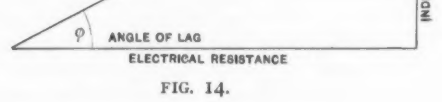


FIG. 14.

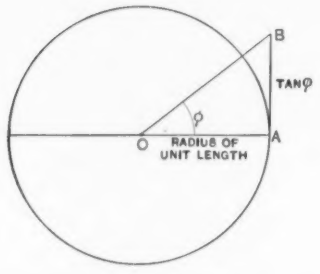


FIG. 15.

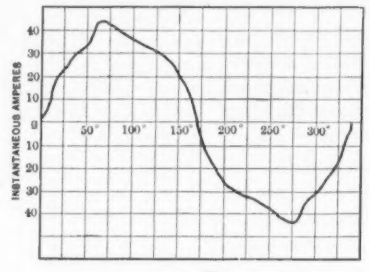


FIG. 16.

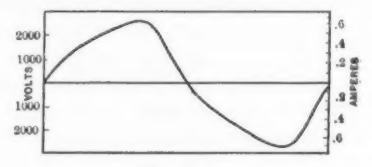


FIG. 17.

The retardation of the current by electromagnetic inertia was shown by Faraday to occur *when the current is changing in value,* and it therefore exercises a marked influence on the *everchanging alternating current.* Faraday showed that the value of the changing current was retarded or lagged behind the value which it might be expected to attain, and which a uniform current under the same conditions would attain. We therefore know that an alternating current will lag behind the phase of the alternating electromotive force which causes it to flow, if there is self-induction in the circuit. The amount of the lag depends upon the electromagnetic character of the circuit. Thus, a straight wire causes less *retardation* or lag than the same wire wound in a helix, because the helix increases the magnetic effect. Inserting an iron core in the helix may increase the retardation enormously, since the presence of the iron again increases the magnetic effect. Faraday said: "If an electromagnet be employed, the effect will be still more highly exalted," as compared with the effect of the plain coil or helix of wire.

Faraday's experiments were mostly carried on with varying or pulsating currents, but later investigators took hold of alternating currents and much attention was given to the laws of flow of alternating currents at the time alternators became known.

We all have at our fingers' ends the well-known ratio generally called Ohm's law, in which it is asserted that a continuous current is equal to the electrical pressure upon a circuit divided by the electrical resistance of that circuit. This so-called law is nothing more than a special statement of a condition which may be recognized as universally applicable to the phenomena of nature. The general statement may be put thus: The result of an effort is equal to that effort divided by the opposing resistance. Thus, for instance, if we stretch an elastic material the amount of stretch will depend upon the ratio of the pull to the elastic resistance of the material; if we try to push a heavy block along the floor the velocity of the block will depend upon the ratio of the force exerted to the frictional resistance opposing the motion; and so we could go on indefinitely illustrating the general applicability in nature of this statement that the result is dependent upon the ratio; effort divided by resistance.

We then have for the flow of continuous currents the rule that current flowing ("result") is equal to pressure ("effort") divided by the opposition to the current flow ("resistance"); but in the case of continuous currents there is no opposition to the flow of the current except electrical resistance (that is, the resistance which is determined by the nature, temperature and dimensions of the conductor), whence we have Ohm's law for the flow of continuous currents.

The fundamental law of the flow of alternating currents follows directly from what has gone before. The alternating current flowing in a circuit is equal to the pressure divided by the opposition to the flow of the current. In this case the opposition is made up of two parts, one the electrical resistance spoken of above, and the other the opposition due to electromagnetic inertia. The latter effect is a sort of inductive resistance and is commonly called *reactance.* The total opposition to the flow of alternating currents which is made up of these two components (resistance and reactance) is called *impedance,* and it is numerically equal to the square root of the sum of the squares of the electrical resistance and the inductive resistance or reactance. These three factors, therefore, bear the same relation to each other as the three sides of a right angle triangle in which the hypothenuse has a length equal to the impedance and the base and altitude are respectively equal to the electrical resistance and inductive resistance (Fig. 14).

The fundamental laws of flow of alternating currents may be briefly stated thus:

1. The current flowing in a circuit is equal to the alternating electromtive force divided by a quantity called the *impedance,* or apparent resistance. This impedance is equal to the square root of the sum of the square of the electrical resistance and the square of the inductive resistance.

2. The alternating current lags behind the alternating electromotive force applied to a circuit containing inductive resistance by a certain angle (as illustrated in Fig. 12). The trigonometrical tangent of this angle is equal to the inductive resistance of the circuit divided by its electrical resistance.

The electrical resistance of a wire composing a circuit depends, as is well known, upon the material and temperature of the wire, its length and its cross section; and it is not affected by the flow of

current, provided the temperature is not affected thereby. The inductive resistance is dependent upon the self-induction (i. e., the electromagnetic condition of the wire) and the frequency of the alternating current. The effect of the self-induction is to retard the rise and fall of the current so that it attains its maximum later than the maximum of the alternating pressure which sets it up; and it also increases the apparent resistance to the flow of the alternating current in the circuit. Thus, if the curve 1 in Fig. 13 is taken to represent the alternating current which flows in a circuit supposed to contain no self-induction, then Curve 2 can be taken to represent the current which flows when there is self-induction. Curve 2 is retarded with respect to curve 1 and reaches a smaller maximum value.

These laws can be put into very simple mathematical form:

$$\text{Alternating current} = \frac{\text{Alternating electromotive force}}{\sqrt{(\text{Electrical resistance})^2 + (\text{inductive resistance})^2}}$$

$$\text{Tangent of angle of lag} = \frac{\text{Inductive resistance}}{\text{Electrical resistance.}}$$

It is usual for brevity to use the letter I to represent electric current, the letter E to represent electromotive force, the letter R to represent electrical resistance, and the Greek letter ϕ to represent the angle of lag. Inductive resistance is equal to a constant (equal to twice 3.1416 + times the frequency of the alternating current times the self-induction coefficient for the circuit. The letter L is usually used to represent the latter coefficient, the letter f is often used to represent the frequency of the current, and the constant, 3.1416 + which enters into a large number of physical equations, is usually represented by the Greek letter π. Inductive resistance is therefore represented by the collection of letters, $2\pi fL$.

Using these symbols, we have our laws of flow represented in the manner that they would usually appear in text books or published articles. Or,

$$I = \frac{E}{\sqrt{R^2 + (2\pi f L)^2}}$$

$$\tan\phi = \frac{2\pi f L}{R}$$

In Fig. 13 the distance from a to b measured in degrees (it being remembered that each degree is represented by a length equal to one three hundred and sixtieth part of the distance $a\ a^1$ representing the length of one period) is the angle of lag ϕ.

I will use numerical examples to illustrate the way in which the laws apply. Let us assume that we have a circuit with four-tenths of a unit, or ohm, of resistance, and one thousandth of a unit of self-induction. What will be the angle of lag when the frequency is sixty periods per second (this is a common commercial frequency)? The formula representing the current lag becomes

$$\tan\phi = \frac{2\pi f L}{R} = \frac{2 \times 3.1416 \times 60 \times .001}{.4} = .943-$$

and the angle corresponding to a tangent of .943— is nearly 43⅓ degrees, which is the value of ϕ.

Now suppose that we increase the number of turns of the wire so as to increase the inductive resistance to double the value assumed above and carefully avoid changing any other feature. Then $\tan\phi$ becomes equal to twice its former value 1.886— and ϕ is a little over 65 degrees. Exactly the same result would have been brought about by using larger wire in the circuit, so that the electrical resistance was reduced to one-half its former value without changing anything else, or by altering both the inductive resistance and electrical resistance, so that the ratio $\frac{2\pi f L}{R}$ is doubled.

It is clear, then, that the alternating current in a circuit may be given any desired lag or retardation, at least up to nearly 90 degrees, by merely adjusting the electrical condition of the circuit so as to properly fix the ratio of inductive resistance to electrical resistance. This may be done by changing the character of the circuits or by introducing into the circuits what are called variable resistance coils, or variable self-induction coils, or it may be done by changing the frequency of the alternating current flowing in the circuit.

When the electric current flows through a circuit the power that is absorbed in the circuit at every instant of time is equal to the product of the pressure at that particular instant and the current flowing at the same instant. In direct current circuits the pressure and current are virtually constant; consequently the power is continually the same and without changes from instant to instant, however long the current continues to flow, provided the indications of voltmeter and ammeter remain unchanged. The indications of these instruments therefore show the average current flowing and the average pressure applied to a circuit, so that their product gives the average power, and we say that power is equal to current times pressure, or, what comes to the same thing, power is equal to current squared times resistance.

The same fundamental principle applies in the alternating current circuit. That is, the power expended at every instant is equal to the corresponding product of the instantaneous current and the instantaneous pressure. Our amperemeter and voltmeter, however, do not indicate these instantaneous values, and it is only when the circuit contains no self-induction to cause a lag of current through the effects of electromagnetic inertia that power is equal to the product of the alternating current and the alternating pressure indicated by the instruments. When the current is displaced with respect to pressure, that is, it is caused, for instance, to have a lag on account of the effect of electromagnetic inertia, the average of the instantaneous values of the power throughout any complete cycle in the alternating current circuit is always less than the product of the current and pressure read from the amperemeter and voltmeter. This product of amperes times volts is generally called the apparent power or volt-amperes in the circuit, and the ratio of the true power to the volt-amperes is caller the *power factor.* When the waves of current and pressure are exact sinusoids (sine curves), this power factor is numerically equal to the trigonometrical cosine of the angle by which the current lags behind the pressure. But the condition of exact sinusoids for both current and pressure can be said to be never met with in practice, and, indeed, it is seldom that either of the curves are exact sinusoids, though pressure waves are not uncommonly made up of curves that approximate quite closely to that form.

We must therefore consider the power factor as simply the ratio between the true power and volt-amperes in the alternating current circuit, and we may say that it is equal to the cosine of the apparent angle of lag in the circuit.

Power may be measured by a wattmeter. This is an instrument which indicates the average of the product of instantaneous currents and pressures in the alternating current circuit. In the case of indicating wattmeters, we have a simple pointer which plays over a scale in a manner similar to the arrangement shown by amperemeters and voltmeters. In the case of recording wattmeters the armature of the instrument is usually caused to rotate continuously when power is being absorbed by the circuit to which it is attached, and a record is made of its rate of rotation or of the number of its rotations. The rate of rotation in this case is proportional to the average of the products of instantaneous currents and pressures. In the indicating wattmeter the rotary effort is balanced by means of springs and the deflection of the needle is thereby caused to be proportional to the average of the product of instantaneous currents and pressures.

The power factor of a single phase circuit may always be found by measuring the power by a wattmeter and the volt amperes by means of an amperemeter and a voltmeter and taking the ratio of watts to volt-amperes.

Moving a Big Telephone Switchboard.

A week or so ago a very neat feat in telephone work was accomplished at Detroit, Mich., by the Michigan Telephone Company at their exchange, when the switchboard, serving 6000 subscribers was cut in two and moved fifteen feet without hindering the service an instant. Not a subscriber in the city was discommoded to the slightest degree. For ten weeks forty-two electricians and scores of other workmen have been preparing for the move and it was accomplished in ten hours. This in itself is remarkable, and not a single instant was the service of a telephone in the entire city out of order.

The west wing of the board was first swung around a distance of fully twenty feet after which the other half was drawn eight feet toward the centre of the room. The wing was swung by jack screws and then the other half of the board was drawn by means of wires fastened to the board at short intervals and extending from it to long iron rods which had been threaded on which large nuts turned by wrenches in the hands of about twenty men slowly drew it forward until it had been moved the entire eight feet, the cables containing nearly a hundred thousand wires being slipped under the floor and into the room below where the state line department is temporarily located.

Electricity at the Pan-American Exposition.

By Frank C. Perkins.

WITHOUT question the electrical attractions at the Pan-American Exposition at Buffalo, N. Y., in 1901 will be of a most interesting character. Director General Buchanan has stated that the plans as laid out by Mr. Luther Steringer, of New York, would produce electrical effects which will not be equaled at the Paris Exposition this year.

The electrical building is illustrated in Fig. 1 and is shown on the block plan, Fig. 2, under No. 13 at the left of the Grand Basin. This building, which was designed by Green & Wicks, of Buffalo, will conform to the general color scheme of the machinery, transportation and other buildings of the exposition. It is to be ornamented with frescoes in reds, greens and yellows, a design of modeled relief work will be finely executed.

The exposition will open May 1 and close October 31, 1901. The work is at present being rapidly pushed forward and special efforts will be put forth to have everything in place on the day of opening.

ELECTRICAL DISTRIBUTION.

The electrical department has announced that the power will be obtained from Niagara Falls through the Cataract Power & Conduit Company, which has the franchise for the distribution of Niagara power within the city limits of Buffalo.

The Niagara current will be transformed at a substation at the exposition grounds from 11,000 volts, as it arrives from the transmission line, to 2200 volts. Several hundred transformer pits are to be located in various parts of the exposition grounds. The transformers located in these pits will reduce the voltage from 2200 to that required for lighting and power. These step-down transformers will be connected by underground conduits to the centers of distribution. Underground cables will be very largely used and rotary transformers will supply direct-current of 110 volts to 500 volts where direct-current apparatus will be exhibited.

INTRAMURAL ELECTRIC RAILWAY.

Plans for the railroad terminals have been approved by the transportation department and are now in the hands of the director-general. The intramural surface electric railway will skirt the entire grounds, near the fence, and enter the grounds over the top of the entrances. From the railway branches will run to the various parts of the grounds for transporting building materials and heavy exhibits. These branch roads will be depressed and covered during the exposition so that they may be used at the close. The intramural electric line will have double tracks and there will be no grade crossings. Its tracks will pass over and under the surface tracks, foot paths, roadways, etc.

It is considered very probable that the International Traction Company, now owning nearly all the electric trolley roads in and about Buffalo and Niagara Falls, will obtain the grant for conducting the surface intramural electric line in the grounds.

ELECTRICITY BUILDING.

In the electrical building will be located electrical exhibits of great interest, and a very large number of manufacturers of electrical appliances have already signified their intention of having an extensive exhibit. The fact that so many countries of South America have taken a deep interest in the Pan-American Exposition has stirred up the manufacturers, who are now exerting themselves to obtain a share of the trade from the South American countries which has heretofore gone to the European manufacturers. The exports of electrical apparatus to South American countries will, it is confidently believed, be largely increased through the advertising of the Pan-American Exposition.

Displays of all kinds in the practical and artistic uses of electricity, together with complete exhibits of the latest polyphase and direct-current generators, motors and other appliances will be conspicuous features of this great exposition.

The electrical building is to be 500 feet long, extending from east to west, and 150 feet wide, giving a floor space for exhibits of 75,000 square feet. The south facade fronts the mall (see block plan 4) and the north fronts the Midway (block plan 15). The east end is in front of the electric tower (block plan 14), while the west end faces the grand canal, which encircles the main group of buildings. The illustration of the electrical building gives an idea of the facades and artistic groupings, the loggias placed at frequent intervals presenting a beautiful effect. The entrance is very high and wide, and is spanned by an ornamental arch, supported on each side by columns, while the towers also have smaller entrances through them.

Fig. 1.—Electricity Building, Pan-American Exposition.

Electric arc and incandescent lamps will be largely employed, many thousands being used in the decoration, and the towers and pavilions at the corners of the building are to be brilliantly illuminated and made gay with banners and flags.

ELECTRIC TOWER.

Work on the plans of the electric tower, which promises to be one of the greatest features of the exposition, is being pushed and the specifications are about completed. It is said it will require five months to get the material for the building, which is entirely of steel, while the actual building of the tower will not take more than two months, and the exterior will be completed during the coming summer.

This commanding steel structure is to stand on a commanding elevation at the north end of the court of electric fountains (Q on block plan). Its base will be semi-circular in form and will be

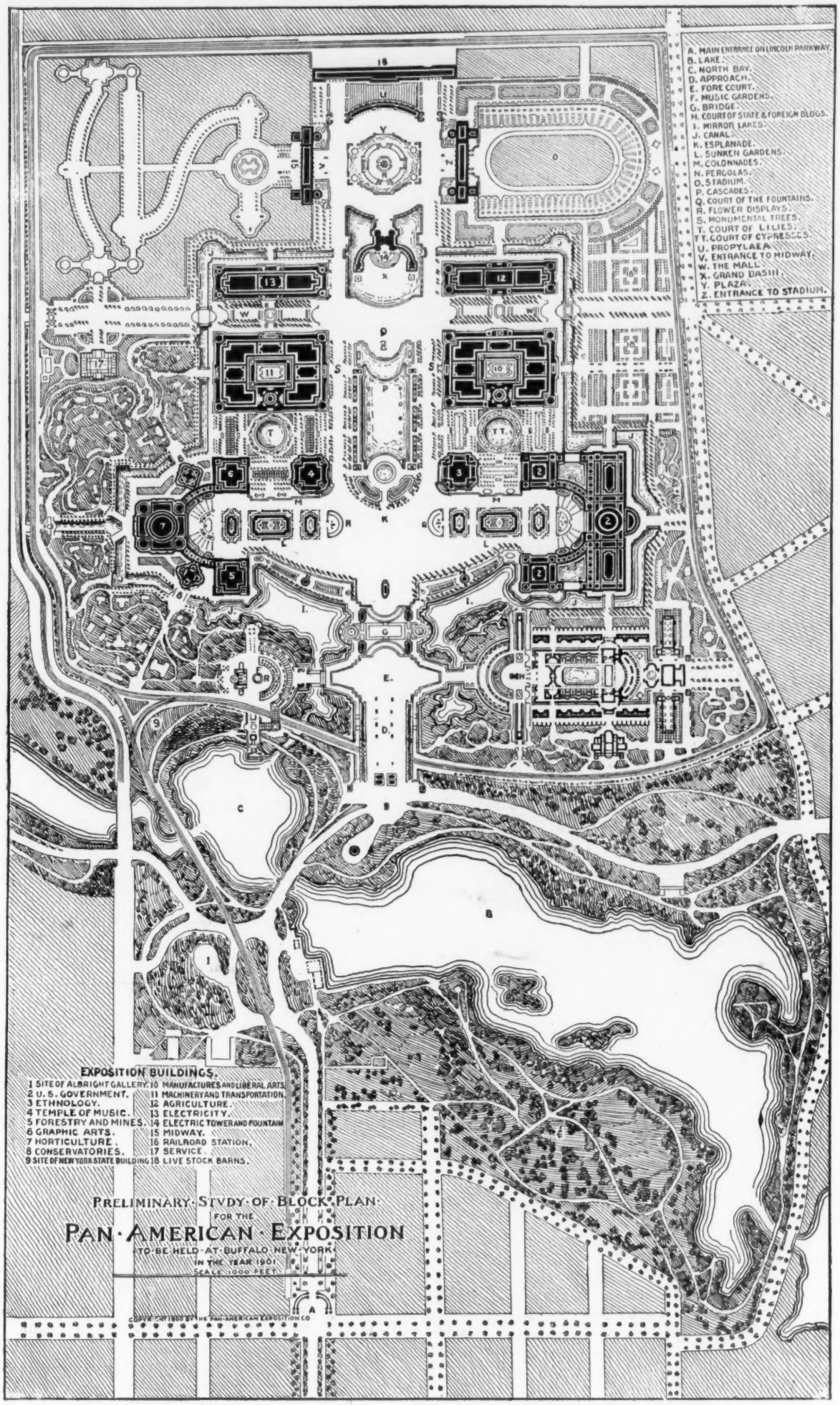


FIG. 2.—BLOCK PLAN, PAN-AMERICAN EXPOSITION.

265 feet by 165 feet in dimensions. The tower divides the court of fountains from the plaza. It stands in a large aquatic basin, and a picturesque bridge enables the visitor to reach it from the plaza.

The base will consist of arch-forming columns, which will rise to a height of 71 feet. On the top of these columns will be a promenade. In front of the tower, partly enclosed by the semi-circular foundation, will be an immense basin of water with one great splashing electric fountain, which at night will be beautifully illuminated with white and colored electric lights. This is indicated at 14 in the block plan.

In the tower, at the height of 70 feet, will be a large restaurant, and promenade floors at various heights, and a balcony near the summit, from which a bird's-eye view of the exposition and the City of Buffalo may be obtained, and even the tower at Niagara Falls will be clearly seen, while the sight of the steamers running up and down Niagara River and out on Lake Erie will be particularly interesting.

The second landing above the ground will be 200 feet high, the third 253 feet and the fourth 292 feet above the base. The distance

FIG. 3.—ELECTRIC TOWER, PAN-AMERICAN EXPOSITION.

from the ground to the extreme top of the great tower will be 350 feet. Rapid-running elevators will carry passengers to the highest landing, 292 feet above the earth. The structural work of the electric tower will be uncommonly beautiful and artistic in design.

It is said that the electric tower will be used in the production of special electrical features. One of these will be an electric waterfall 30 feet wide and of 70 feet descent, from a niche in the tower. The tower itself is of imposing design and intricate workmanship.

COURT OF ELECTRICAL FOUNTAINS.

Immediately north of the esplanade (marked K in the block plan) is the grand court of fountains (2). This is to be the great centerpiece of the exposition. The principal electrical displays will be produced in this place. There are to be installed in this court more than 100,000 electric incandescent lamps of all colors, and great efforts will be made to produce the most perfect results without shadows so common in arc-lighting effects. The many fountains in the great basin of the court will be made brilliant at night, and beautifully colored lights will be artistically arranged, while the focusing arc lights will be used below the fountains for obtaining the usual sheaves of wheat and more recent designs in electric founain displays.

NIAGARA ELECTRIC POWER AT THE EXPOSITION.

The many electrical features of the Pan-American Exposition are made possible by the fact that electric power from the largest power plant in the world, at Niagara Falls, is to be provided in unlimited quantities. This great power plant is only a half hour's ride from Buffalo, and is one of the greatest sights for visitors to the exposition to include in their itinerary. The Niagara Falls Power Company is putting forth every effort to supply the great demand and the new wheel pit is rapidly being constructed. Fifty thousand horse power more may soon be available for the Pan-American Exposition and other power users, who are so rapidly locating at Niagara Falls, along the Niagara frontier, and at Buffalo, where even at the present time more than one-half the entire power used in the city is supplied from the great Niagara power plant.

The Telephone, Telegraph & Cable Co.

According to a despatch from Philadelphia the Telephone, Telegraph & Cable Company of America is desirous of securing all the franchises of the telephone companies in Philadelphia, except the Bell, in order to secure a new franchise for itself. It is stated that the existing companies there have not had the necessary capital to fight successfully the Bell corporation. This is the explanation why no progress has been made since acquiring the charters and franchises. The Standard Company actually laid some conduits and wires on Market street from the river front, and with its franchise taken away the Telephone, Telegraph & Cable Company would be in a position to dictate terms for such of this property as might be wanted. It looks as though the Telephone & Telegraph Company preferred to get a new franchise to taking up one of the existing companies. The franchises of six of these inactive telephone companies were repealed recently by the Philadelphia city councils, as noted in these columns last week.

More Subways in Boston.

The experience with subways in Boston is so satisfactory that steps are being taken to extend the system. A bill has been introduced in the Massachusetts Legislature by the Citizens' Association to build another subway extending under Washington street from Pleasant street to Adams. The bill provides that the subway shall be constructed by the Boston Transit Commission, the cost to be paid by the Boston Elevated Railway Company. At the end of thirty-seven years the city may purchase the subway at cost price. The company may issue stock to pay for the cost of construction, which is roughly estimated at $4,000,000. Herbert L. Harding, counsel for the Citizens' Association, claims that it was a public necessity, since the addition of the elevated cars in the present subway would inconvenience and delay travel; and that the surface cars will, to a great extent, be excluded from the subway.

Report of the Massachusetts Board of Gas and Electric Light Commissioners.

The fifteenth annual report of the Board of Gas and Electric Light Commissioners of Massachusetts, covering the year 1899, shows that there are 24 companies engaged in that State in the supply of both gas and electric light and 74 in the supply of electric light only; 14 cities and towns own electric lighting plants and three own plants for both gas and electricity. During the year the receipts of the municipalities for electricity sold to private consumers were $95,284.83. Substracting this from operating expenses, interest on notes and bonds, depreciation and losses, the expenditure for municipal lighting was $147,357. The number of municipal lights in use was 2712 incandescent lamps, of which 2280 were of 25-cp, and 1325 arc lamps, of which 1057 were of 1200-cp. Allowing $10 per year for the incandescent lamps, the charge against the 1325 arc lamps is $120,237, which is at the rate of $81 per lamp per year. Of 62 companies operated by private capital, 29 paid no dividends. The following rates of dividend are paid by the remaining companies: One company, 2½ per cent.; two companies, 3 per cent; seven companies, 4 per cent.; two companies, 4½ per cent.; four companies, 5 per cent.; nine companies, 6 per cent.; two companies, 7 per cent.; six companies, 8 per cent.

CURRENT NEWS AND NOTES.

RUMFORD MEDAL.—The American Academy of Sciences has awarded the Rumford medal to Mr. Charles F. Brush as a recognition of the part he played in the development of arc lighting.

HUGHES' LEGACIES.—In addition to the legacy of $20,000 to the English Institution of Electrical Engineers, which was noted in these columns, Prof. Hughes also bequeathed the same sum to the English Royal Society and the French Academy of Sciences.

MR. C. F. SCOTT, chief electrician of the Westinghouse Company, delivered a lecture on Friday, March 16, before the Engineering Students of Purdue University, Lafayette, Ind., on "Modern Methods for the Distribution and Long Distance Transmission of Electric Power."

TO TAX FRANCHISES.—The Bell Telephone Company has made objections to the valuation placed upon its special franchises in Buffalo and Rochester. The franchise in Buffalo has been valued at $647,000 and that in Rochester at $260,000. The company maintains that the former should be reduced to $366,262 and the latter to $52,400. The company now pays taxes to the city of Buffalo on a valuation of $325,800. In Rochester it pays on a valuation of $52,400.

DELAWARE INCORPORATION LAWS.—Under the recently enacted incorporation laws of Delaware taxes are only one-half those of any other state; stockholders' meetings can be held outside of the state and books may be kept out of the state provided duplicate sets are kept in Delaware. The effect of this leniency is shown in the fact that twenty-two large concerns were incorporated in Delaware during 1899, with an aggregate capitalization of $318,000,000.

SOUTH ATLANTIC CABLES.—The recent notice that a cable had been laid from Cape Town to St. Helena, and, later, extended to Ascension Island, is now supplemented by advices from London that a cable has been laid between St. Vincent and the Island of Ascension, and is now open to traffic. This completes the telegraph route to South Africa by way of Madeira and St. Vincent. The rate to Ascension Island and to St. Helena is 98 cents per word from London.

AMENDING THE RAPID TRANSIT LAW.—A bill was introduced in each house of the legislature at Albany on March 13 to amend the New York City Rapid Transit law, one of the main purposes of which is to extend the jurisdiction of the present Rapid Transit Commission to all of the boroughs of the city. The proposed amendments to the law providing for a cash deposit with the city comptroller in place of the continuous bond required from the Rapid Transit contractor is also incorporated in the bill.

TELEPHONE REPEATERS.—The interest felt in the subject of telephone repeaters is illustrated by a telegraphic inquiry received, asking: "Is there such a thing in use as a telephone repeater, or is there a demand for such an instrument?" Had our querist noted the discussion on the subject in these columns in the issues of June, July and August of last year, he would have learned that there is a sufficient demand for such an instrument to warrant the offer of a million dollar prize—and incidentally he would have saved the cost of a telegram.

PITTSBURG ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association of Pittsburg, Pa., held another meeting on March 16 to make further arrangements for the coming national convention to be held in that city. The date has now been set for April 6, but this is apt to be changed again. The contractors say that the manufacturing supply men are now getting their prices ready for the year, and that they will wait to see what they are so as to prepare a schedule of their own and present this to the supply men for their consideration. It is reported that if the contractors cannot make a satisfactory arrangement with the supply men which will enable them to make a profit on their work they will build a factory in which all the contractors shall have an interest, and manufacture sundries.

AUTOMOBILE SYMPOSIUM.—The 204th meeting of the New York Electrical Society will be held at 8 p. m., March 22, at the College of the City of New York, Twenty-third Street and Lexington Avenue. The meeting will be devoted to the discussion of the status of automobile development to-day as shown in vehicles operated by electricity, gasolene and steam. Mr. A. L. Riker will speak on "The Advantages and Limitations of the Electric Automobile," giving a description of its construction and operation. Mr. C. J. Field will discuss "The Present Development of the Hydro-Carbon (or Gasolene) Type of Automobile," including an outline of the industry in this country and abroad. Mr. J. A. Kingman will review the history of "The Steam Carriage."

PARIS EXHIBITS ON THE PAUILLAC.—The French freight steamer Pauillac, which sailed from New York Feb. 7, had not arrived at Havre up to March 21, and has not been sighted since Feb. 11. The cargo of the vessel consisted largely of American exhibits for the Paris Exposition, among which were many publishers' exhibits, including complete files of periodicals, the loss of which would be irreparable. Another part of the cargo consisted of electrical machinery for the equipment of the movable platform for the transportation of passengers about the exposition grounds. The vessel has been reported lost in a telegram from the Chicago office of the American Paris Exposition Commission. The owners of the vessel, however, have despatched steamers to search for her, probably on the assumption that the vessel is drifting with disabled machinery.

STORAGE BATTERY DECISION.—The U. S. Circuit Court of Appeals for the first circuit, consisting of Judges Putnam, Aldrich and Brown, has handed down a decision in the case of the Electric Storage Battery Company against the Hatch Storage Battery Company, affirming the decision of the Circuit Court of Judge Colt, wherein the Hatch battery was held to be an infringement of the Brush patent. An injunction was granted against the further manufacture and sale of the Hatch battery. The opinion says that the Hatch battery "is clearly an infringement," and that "it also seems clear to us that the respondent has taken the complainant's device." The court therefore affirmed the order applied for, with special reference to the first claim of the Brush patent, which is the basic claim on "a plate or suitable support primarily coated or combined with a chemically applied oxide of lead or equivalent lead compound." This litigation has been pending for the past three years.

ELECTRIC METER PATENTS.—Among the patents granted March 13 were four on electric meters and electric metering, issued to Lyman C. Reed, and one on an alternating current meter, issued to William H. Pratt. Among the Reed patents, the one earliest in date of application has for an object to provide means whereby the correct measurement and registration of the current consumed may be obtained on small installations through all ranges of load. This object is carried out by providing means of normally short-circuiting the starting coil so that it may be made of sufficient strength for the meter to operate successfully on a small load, and at the same time overcome the creeping action of the instrument when no current is being consumed. The second Reed patent provides means whereby a true record of the current consumed in installation may be obtained through all ranges of load. Two meters of different capacities are employed and means provided for automatically coupling the meters in multiple when the load is greater than the capacity of the small meter. The action of coupling the meters is entirely automatic and performed by a switch actuated by a solenoid. The third patent has the same object in view as the one just mentioned, but instead of coupling the two meters in multiple on large loads, they are cut into and out of circuits separately by means of an automatic switch controlled by a thermostatic circuit controller in the service circuit. In the final Reed patent, the same object is obtained by employing a plurality of meters of different capacity, and providing means of switching the meters into the circuit separately; in this case the switching is controlled by a magnetic circuit-controller, connected with the positive and negative service wires. The Pratt patent describes an intergrating wattmeter of the induction motor type, which is designed to obviate error from the friction of the parts, and to counteract any tendency to run fast on light load, should there be any dissymmetry of the shunt coil. The shunt circuit of the meter is provided with an auxiliary coil in inductive relation to the damping disc, and usually out of inductive range of the motor coils. This coil is provided with an adjustable shading device, by which a creeping or shifting polar field may be obtained, which will exert a slight forward torque on the disc sufficient to balance the friction of the parts.

FRANKLIN INSTITUTE.—The next stated meeting of the Electrical Section of the Franklin Institute, Philadelphia, will be held on the evening of March 27. Mr. Adam Bosch, superintendent of fire-alarm telegraphs of Newark, N. J., will present a paper entitled "Fire Alarm Telegraphs." A special meeting of the same section will be held on the evening of April 10, at which Mr. Charles F. Scott, of Pittsburg, Pa., will read a paper on "Modern Central Station Practice."

PUBLIC OWNERSHIP OF EVERYTHING.—The National Socialist Democratic Convention held in Indianapolis recently, adopted a platform which, among other things, advocates the public ownership of all railroads, telegraph and telephone lines, all means of transportation and communication, waterworks and electric light plants and other public utilities. Another plank advocates the public ownership of all gold, silver, copper, lead, coal and other mines; also all oil and gas wells.

ELECTRIC RAILWAYS IN FRANCE.—It is proposed to build an electric railway between Lyon-Bellecour and Charbonnieres, and the plans have been approved by the municipal authorities. In Paris it is proposed to build an electric railway from the Place de la Republique to Place de la Concorde; from the Eastern Railway station to the Place de la Concorde, and from Joinville-le-Pont to Villiers-sur-Marne. The present electric railway between Pantin and Ivry is to be extended.

METHOD OF STARTING SINGLE-PHASE MOTORS.—A patent was issued March 13 to Eugenio Cantono of Rome, Italy, on the method of starting asynchronous and synchronous single-phase motors, which consists in drawing out the armature while in the position of rest, and causing it on return to be given a movement of rotation by transforming a simple movement of translation into a helicoidal movement by means of a screw on the shaft and a pin acting as a nut in the operating lever.

PROF. H. A. ROWLAND was appointed a foreign correspondent of the Berlin Academy of Sciences at its recent 200th anniversary meeting. The German Emperor in opening the meeting said: "The academy leads mankind to a deeper knowledge of divine truth. In the words of Goethe, the theme of the world's history is the conflict between faith and an unbelief and the influence of God over the human race. So may God grant, as Leibnitz desired, that science in all ages may promote the honor of God and the welfare of humanity."

A BATTERY CHARGING DYNAMOTOR.—MM. Legros and Meynier have designed a singular form of dynamotor for charging storage batteries. There are two windings, the motor winding being of the usual drum type with a commutator. The second winding, however, consists of a coil of wire of large size fixed transversely in the drum armature core and connected to a two-part commutator. The second winding thus corresponds to a Siemen's "shuttle," and gives a pulsating current. The designers very oddly claim that by the use of this design the weight of the dynamotor is very largely reduced.

A WORK BY HERTZ.—Heinrich Hertz at his death left an unfinished work of which a translation into English has appeared under the title of "The Principles of Mechanics Presented in a New Form" (Macmillan). The manuscript had been edited, at the desire of the lamented author, by Prof. P. Lenard, and the present translation, by D. E. Jones and J. T. Walley, has received the care of Prof. Lenard. The book is an attempt to elaborate with a strict logic a conception of dynamics which excludes action at a distance. The work is preceded by an introduction from the pen of Helmholtz, and contains no complicated mathematics.

INDUCTION MOTOR.—In a patent granted March 13 to W. G. Rhodes, of Stafford, England, a method is described for checking the current in the rotor winding of an induction motor on starting up. The rotor winding is connected by means of the ordinary collector rings and brushes to a switch; by means of this switch the winding can be connected to suitable portions of the stator winding or main supply circuit, and in such a way that an opposing e. m. f. can be applied to the rotor winding on starting, gradually diminished as the speed of the rotor increases and finally cut out altogether when full speed is attained. The switch comprises a moving contact or slider and a series of insulated fixed contacts electrically connected to different points of the stator winding. By moving the slider along these contacts in one direction, a counter e. m. f. can be impressed upon the rotor winding at starting, and removed upon the opposite motion of the switch.

NO PREMISES AND A CONCLUSION.—We have received the following query from an anonymous correspondent, in which logical method appears to be somewhat inverted: Will you kindly answer the following questions in your next issue and oblige an inventor: First, How high up do you have to go to send an electric current through the air so as to send a wireless message? Second, How wide and how deep is that air current through which the message is sent and also how far can you send it? Can you send it when the wind blows hard? Is it sent by dynamo or battery power? How strong a current is in this electric power? If you will answer these questions for me, I will then show you how an enemy can steal any message sent through the air currents. Further, I can show you how you can kill the electric current in the air and make the air current useless a short distance away from the place it is being sent, although it is better to be one mile or more away than too close; 1000 yards is as close as you can take the current out of the air successfully. These ideas can be proven by those that desire to test, and also some others which will open the eyes of some of the experts when they become public.

ELECTROLYTIC PRODUCTION OF CAUSTIC SODA.—A patent was granted March 13 to Henry S. Anderson, of Springfield, Mass., which describes an apparatus for producing caustic soda from brine by electrolytic action. Through the walls of the electrolyzing cell, which is lined with insulating material, are placed pencils of carbon which form the anode of the cell. The cathode consists of a layer of mercury covering the floor of the cell. When the electric current is passed from the anode to the cathode, its path is down through the lower part of the electrolyte and the brine is thereby separated into chlorine and sodium; the former works its way to the top of the cell and escapes in the form of a gas; and the sodium is taken up by the mercury and combines therewith to form an amalgam. A centrifugal pump withdraws the mercury from the cell and forces it into a washing chamber, in which the sodium is oxidized and absorbed by the water, when the purified mercury is returned to the cell. The operation of the whole system is continuous. Fresh brine is continuously supplied to the cell and fresh water to the washing vat. The mercury is kept in continuous motion by the pump, taking up the sodium in the cell and depositing it in the washing vat. It is thus only necessary to supply brine, water and electric current and keep the pump running.

ELECTRIC FURNACE.—A patent was issued March 13 to E. G. Acheson on an electrical method of heating, roasting, treating, purifying or converting materials requiring a high temperature, or which require to be protected from the atmosphere or treated in a closed furnace. The method is stated to be especially adapted for the purification of carbon and the converting of amorphous carbon into graphite. The shape and configuration of the furnace are such that they naturally fall into a pile or mass, having a slope corresponding to what may be termed a "natural gravity slope." Means are provided for continuous feeding and for removing the treated material from the base of the pile in a relatively cool condition. The claims of the patent are on a method of continuously supplying the material to be treated to the apex of a pile, having sides of the natural gravity slope and heating the same by passing all portions of the material between electrodes, the working faces of which are between the slope of the pile, and delivering the treated material from the base of the pile. Another patent of the same date to the same inventor describes a process of producing graphite cheaply and in a practically pure state by electrical means. Anthracite culm is subjected to a sufficiently high temperature for a sufficient time to volatilize the impurities. A reaction occurs prior to volatilization of the impurities between the latter and the associated carbon—resulting in the formation and destruction of a carbide, such, for instance, as carbide of silicon or iron. The amount of impurities not being sufficient to form a carbide of all the carbon at one and the same time, a catalytic action occurs and practically all the carbon is converted into graphitic form before the final volatilization and the escape of the impurities, even though a relatively small amount of the impurities be present. The process is carried out in an electric furnace, in which the materials are protected from atmospheric influences, such as the well-known furnace used in the manufacture of carborundum.

INCANDESCENT LAMP FILAMENT.—A patent was granted March 13 to Georg Alefeld, of Darmstadt, Germany, on a method for producing filaments for incandescent lamps. The completed filament consists of a core or interior of one of the highly infusible metals of the platinum group, such as osmium, rhodium or alloys of the same, covered by an adhesive coherent coating of one of the luminous earthy metals, such as thorium, zirconium and the like. The pencil thus produced can be used as a substitute for the ordinary carbon filament in a bulb. The core is heated by an electric current, and heats in its turn the exterior coating of luminous earthy metal to incandescence. The process of manufacture of the filament is described in minute detail.

THE AUSTIN WATER POWER PLANT.—Prof. Thomas U. Taylor, of the University of Texas, has kept a complete record of the soundings of Lake McDonald, at Austin, Texas, for the past seven years. The soundings show that 48 per cent. of the original storage capacity of the lake is now mud. This lake was created by the building of a great dam across the Colorado River at a cost of $1,000,000, for the purpose of supplying power for the municipal operation of the electric light and street railway systems of Austin. It will be remembered that the power supply has been greatly diminished and practically exhausted on two or three occasions during the past year, which failure was attributed largely to leaks in the dam. The operation of the Austin municipal plants have suffered quite severely on each occasion, and the question of abandoning the lake power and substituting therefor steam power has been seriously considered.

MASSACHUSETTS STREET RAILWAYS.—The annual report of the Massachusetts Railroad Commissioners for the year ended Sept. 30 shows that the gross earnings from operation of the street railways in that state were $1,236,145 larger, and the net earnings $530,388 larger than the year before. The ratio of operating expenses to gross earnings, 68.20 per cent., was less than that of the preceding year, when it was 69.01 per cent. The net divisible income after paying interest, taxes and other charges, was less by $31,060 than in 1898, while the gross amount of dividends declared was $242,165 larger; so that the surplus balance for the year (which was $184,544) was $273,225 less than the preceding year. The total income of the companies from all sources, for the year was $19,519,337.68, and the total expenditures (including dividends) were $19,334,793.87, leaving a net balance of $184,543.81 to carry to surplus. The balance of total income above operating expenses was $7,140,851, and the interest and other charges amounted to $4,637,909, leaving as the net divisible income $2,502,942, which was less by $31,000 than the corresponding net for 1898.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the regular monthly meeting of the Engineering Association of the South held March 8 at Nashville, Tenn., a paper on "Gas Engines and the Economy of Gasoline Engines for Small Power," was presented by Mr. John Wilkes. The writer gave a brief history of the development of the gas engine; a description of the principle of operation and manner of construction. The various types commercially before the public were reviewed, the advantages and disadvantages of each being pointed out. The cost of operation of several gas engines, varying in horse-power from 2 to 30, under the writer's supervision was given, the figures showing remarkably low costs. For small power and at isolated locations the gas engine was declared to fill a long felt necessity. However, it was shown that the gas engine might yet be greatly improved along the lines of simplicity of construction, more efficient manner of starting and steadiness in running. The paper closed with the expression of the opinion that the future would see rapid development of this power and the adoption of such engines in greatly increasing numbers.

LECTURE BY MR. SPRAGUE.—Mr. Frank J. Sprague on the evening of March 2 delivered a lecture before a large audience at the Brooklyn Institute of Arts and Sciences, entitled "The Regulation of Electric Apparatus on Electric Railways." Mr. Sprague divided the methods of electric railway passenger transportation into three classes, viz.: the single car operating independently; the locomotive pulling trail cars, and the multiple-unit system, or an aggregation of units into trains and provided with a secondary control. He reviewed the beginning and development of the first method and, passing to the second, outlined its underlying ideas and theories, and described the Baltimore & Ohio tunnel locomotives and the proposed equipment of the Central London Railway. The larger part of his lecture was devoted to a description of the third method, i. e., the multiple-unit system, and he showed the advantages such a general system, when fully developed, must possess. Among these are independence and facility of operation, increased schedules, reduced strains, increased density, better equipment, reduced number of cars, simplicity of operation, ease of inspection, economy, safety and least cost. He summed up such a system as being an aggregation of cars having identically the same characteristics as single cars in the matter of load, capacity, motive equipment, rate of acceleration, etc., and yet permitting any combination to be made without the slightest thought being given to pairing of electrical circuits. Mr. Sprague discussed at some length the application of electric equipment to long trunk lines, and stated as his opinion, that the time had not yet come for the entire displacement of steam by electricity, and would not arrive until the fuel conditions shall make necessary the adoption of electricity and the utilization, even at increased cost over the present practice, of water falls or tide movements. He stated, however, that although the electric motor has not displaced the steam piston, nevertheless the hum of the motor has become the sound of emancipation of man and beast, just as it is said that "The throb of the locomotive is the heartbeat of civilization." Mr. Sprague closed his lecture, which was illustrated throughout with experimental demonstrations, with a reference to trunk lines, discussing in some detail street, elevated, underground lines and suburban traffic, and referring to some of the changes which will have to be brought about before the world will see the steam engine displaced by the electric motor.

LETTERS TO THE EDITORS.

Short-Circuit Curve of Alternators.

To the Editors of Electrical World and Engineer:

Sirs:—A distinguished man of science, the late Thomas H. Huxley, prefaced a volume entitled "Essays upon Some Controverted Questions," with the following remarkable words:

"Of polemical writing, as of other kind of warfare, I think it may be said, that it is often useful, sometimes necessary, and always more or less of an evil. It is useful, when it attracts attention to topics which might otherwise be neglected; and when, as does sometimes happen, those who come to see a contest remain to think. It is necessary, when the interests of truth and of justice are at stake. It is an evil, in so far as controversy always tends to degenerate into quarreling, to swerve from the great issue of what is right and what is wrong to the very small question of who is right and who is wrong."

I was forcibly reminded of the truth of this passage when the letters of Messrs. Rothert and Heyland fell under my eyes in your issue of March 17. No one can doubt, after a perusal of these letters and their predecessors in the *Elektrotechnische Zeitschrift*, and, I may add, of my own letter in the ELECTRICAL WORLD AND ENGINEER, January 27, that the contending parties have not succeeded in abiding by "the great issue of what is right and what is wrong." If, however, our lively discussion has contributed to clearing this interesting topic in the field of electrical engineering from some obscurity, I for my part, gladly forgive the authors of these letters their shortcomings in the refinements of controversy, hoping that they will be no less generous and forget any personal remarks of mine which did not pertain to the subject. This can be done the more justly as the perusal of the last letters of Messrs. Heyland and Rothert makes me believe that we differ far more in seeming than in reality.

ERIE, PA. B. A. BEHREND.

Rationalization of Electrical Units.

To the Editors of Electrical World and Engineer:

Sirs:—Prof. Fessenden has hit upon a scheme for the simplification of the fundamental electrostatic and electromagnetic units of quantity, to which I give hearty approval, and I am constrained to believe American electricians cannot do their profession a kindlier service than to support most of his suggestions before the Interna-

tional Congress at Paris next summer. The terms *permity* and *capity* appeal to me as especially apt, and of a character to be appropriated by old as well as young engineers without half the effort that has been necessary in relinquishing "coefficient of self-induction" for "inductance."

I will also gladly give my support to the adoption of terms after the type of "resistity" and "conductity" for the sake of uniformity, and because I believe they have in them more force than some other forms suggested.

As regards Prof. Fessenden's other suggestions, I think terms of the types of "volsta" and "volma" in very good taste; but I doubt either the wisdom or the utility of increasing the number of suffixes, as it is hardly essential that the several differentials for space, area, volume and time should be specifically designated. And so also as regards the prefixes. What we need is simplicity, and not multiplicity of terms; and care must be taken that, in the effort to secure maximum simplification, a nomenclature is not evolved complex in the multiplicity of its simplifications.

The average student will doubtless be puzzled to grasp the true significance of "permity," when it shall become necessary to formulate his ideas, without having in view matter of unit permity by which to draw comparisons; but this will be as nothing when compared with the trouble now experienced in grasping the idea of the present "unit pole."

For his clearness of vision in conceiving of this step in the interest of simplicity, Prof. Fessenden deserves our hearty thanks, whatever the future may hold.

W. E. Goldsborough.

Lafayette, Ind.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

Dynamos, Motors and Transformers.

Dynamo Design.—E. K. Scott.—The first part of an illustrated article on some mechanical details of dynamo design. On bed-plate design he notices the following points: There should be as few machined joints as possible between the armature spindle and the floor line; horizontal surfaces should be cambered, and the corners should be true curves, not simply sections of a circle; flat vertical surfaces should be relieved by beaded hand holes, these also forming convenient places to hook on the sling chains; a useful detail, especially for small machines, is to allow for a flange running along each side of the casting, so that in case the usual position of foundation bolt is not suitable, it is an easy matter to drill another hole further along the flange. He then gives brief illustrated descriptions of some types of field magnets of British make, and makes some short remarks on slide rails, winding cups and armature cores. As to the ventilation of armature, he thinks that only in the very largest two-pole machines, where the watts lost in the armature have increased at a greater ratio than the cooling surface, arrangements for passing an air current into the interior of the core should be considered. Air passages are sometimes arranged for by building the core on gun-metal spiders, but it is almost as good electrically, and certainly much cheaper, to carry the core discs right down to the shaft and provide for the air by punching holes or recesses.—Lond. *Elec. Rev.*, March 2.

Efficiency of Dynamos.—An editorial calling attention to the fact that the determination of the efficiency of a dynamo is much easier by a purely electrical method than by a method in which both mechanical and electrical quantities are to be measured. Whenever the dynamo is driven by a gas engine, steam engine or turbine, the power input of the dynamo can be determined only mechanically, and there is then an uncertainty as to where and how the power is to be measured; this should be obviated by strict regulations. (This has been done for this country by the Standardization Rules of the Am. Inst. E. E.).—*Elek. Zeit.*, Feb. 15.

REFERENCES.

Commutation of the Direct Current Dynamo.—Continuations and conclusions of the summarizing article noticed in the Digest Feb. 3. —Lond. *Elec. Rev.*, Jan. 19, Feb. 9, 23.

Dynamo Electric Machines.—Guilbert.—Illustrated descriptions taken from patent specifications.—*L'Eclairage Elec.*, Feb. 17.

Induction Motor Generators.—A very short illustrated description of the 30-kw three-phase motor, connected to a direct current generator described in the previous issue. Also of the transformer used with this motor in Buffalo, which is said to be the largest polyphase transformer in this country.—*St. R'y Jour.*, March.

Preventing the No-Load Loss in Transformers.—An illustrated description of the transformer cut-out, devised by Mueller, noticed in the Digest Oct. 21.—*West. Elec.*, March 10.

Lights and Lighting.

Nernst Lamp.—An article giving brief illustrated descriptions of different forms of the Nernst lamp, taken from patent specifications of the General Electric Company of Berlin, which have just been published. (See also Digest, March 3, and the article of McA. Johnson in the Elec. World and Eng., March 3.) These patents relate to principles, and the practical lamp may differ somewhat from the forms described. In the adjoining figure the simplest form of the Nernst lamp is illustrated. For lighting with an alcohol lamp there is a hole in the globe directly below the incandescent body *g*. There are other holes, *b b*, which allow the heated air to escape. The incandescent body *g* is supported on short thin platinum wires melted into the glass rod *f*; *h* are stronger metal wires which can be fixed into the tube *e*. In this way the incandescent body *g* may be easily replaced. The next form described is for automatic lighting and is identical in the principle with the lamp in Fig. 1 of McA. Johnson's article. The next form is a slight modification of the same principle. Another patent relates to the resistances which must be connected in series with the electrolytic incandescent bodies on account of their negative temperature coefficient; if they would be used without resistances in series, even small variations of the voltage would be able to increase the current so that the body burns out. As resistances for such purposes, materials with a high positive temperature coefficient ought to be used, such as iron, nickel, platinum, etc. It is best to place the series resistance in the conductor which is used in common for the heating body and the incandescent body, in order that it becomes heated so as to diminish the first rush of current through the cold wires. In order that the resistances and the heating body may attain the best required temperature as quickly as possible, the resistance wires are wound on insulating rods of very small mass. Another patent relates to the joints between electrolytic and metallic conductors, as noticed in the Digest Dec. 2. Another method, described in a patent of Siemens & Halske, is to bring the ends of the incandescent body to a white heat in an oxy-hydrogen gas blowpipe and to dip them into powdered boron, silicium, etc., and to repeat this process until the ends are well impregnated and plastic so that the metallic conductor may be imbedded in it; when cooled the joint is strong. The General Electric Company of Berlin has also tried to place several incandescent bodies in parallel in one lamp. They may be placed either so that the heating body heats one incandescent body until it glows, and that this body then heats the next incandescent body and so on, so that finally all incandescent bodies glow at the same time; or they may be placed so that one incandescent body does not heat any other up to glowing. in which case it can be arranged that when one burns out, another begins to glow. In a lamp of the British Thomson-Houston Company the interruption of the current supplied to the heating body is made by a thermostat, which consists of two metallic strips of different coefficients of expansion and, when heated, stretches and

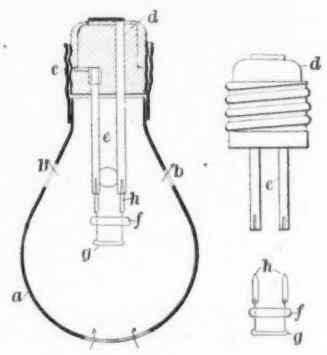


FIG. 1.—NERNST LAMP.

FIG. 13.—AN ELECTRIC TRUCK IN EMERGENCY SERVICE.

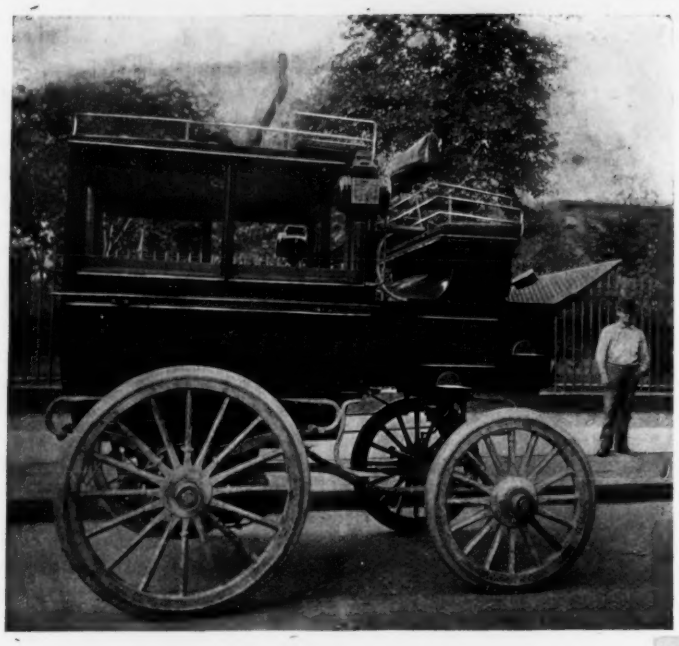


FIG. 16.—THEATRE BUS.

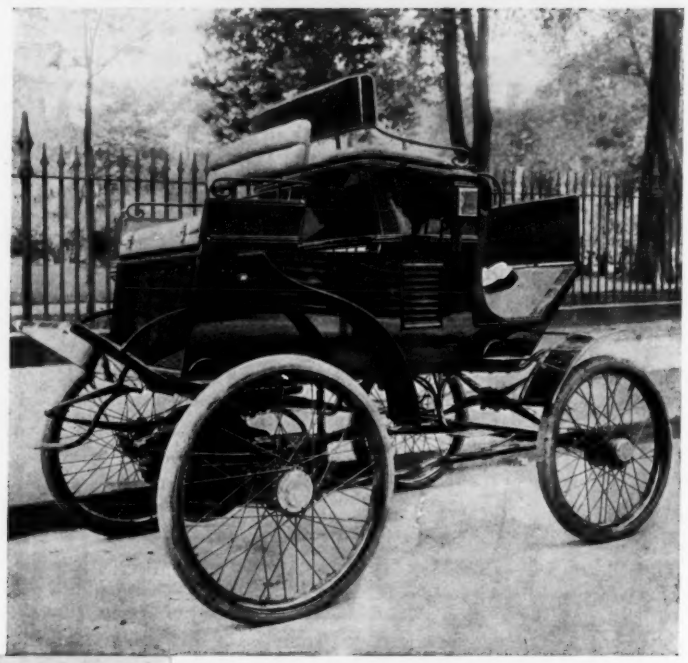


FIG. 17.—DOS-A-DOS.

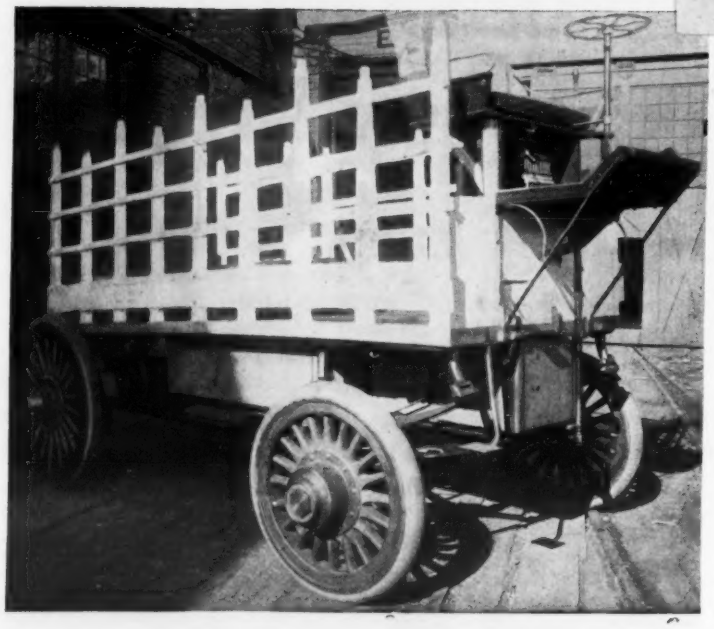


FIG. 18.—FOUR-AND-A-HALF TON TRUCK.

FIG. 19.—DEMI-COACH.

Fig. 14.—Arrangement of Battery for Full Head Room.

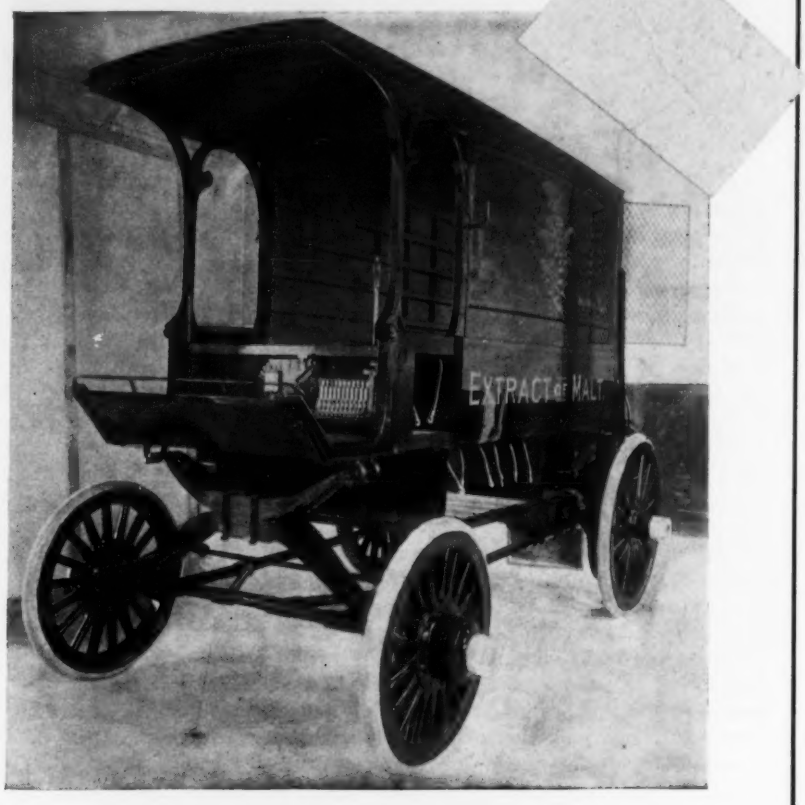


Fig. 15.—Delivery Wagon, Sub-divided Battery.

Some Types of Riker Electric Automobile Vehicles.

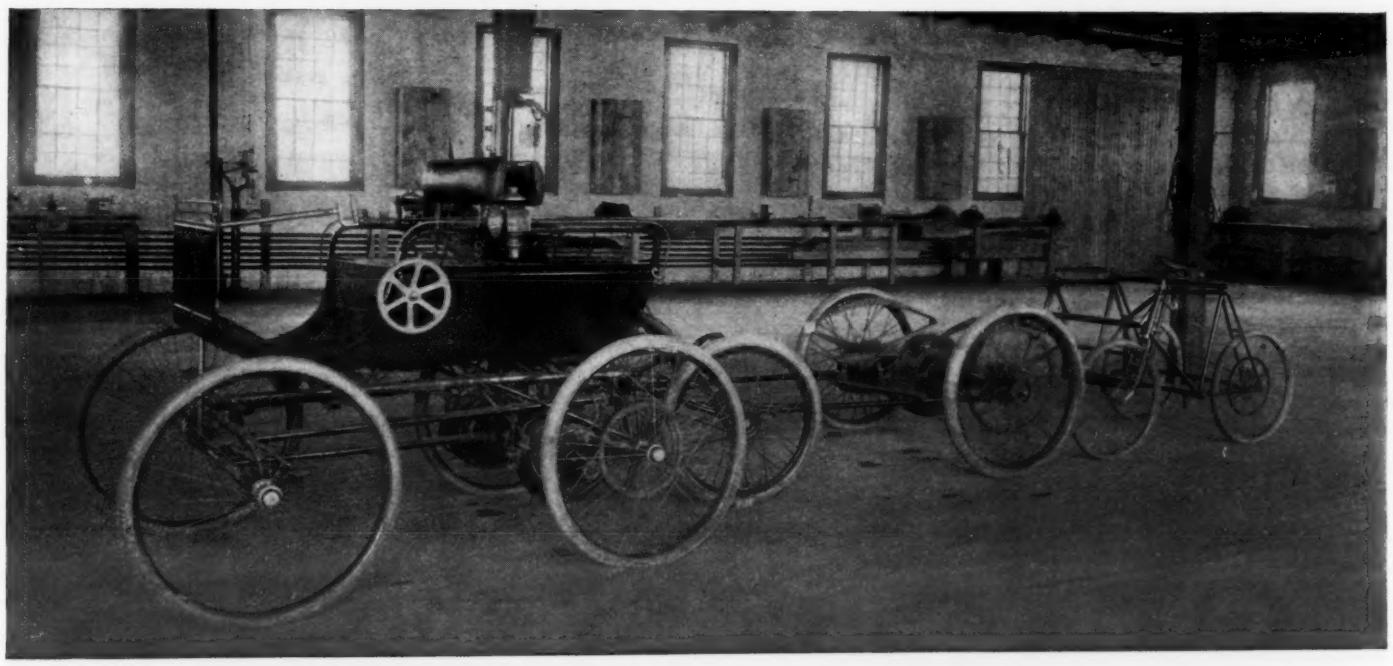


Fig. 20.—Historic Riker Vehicles.

breaks the current. In a lamp of the Union Electric Company the heating of the incandescent body is made by an arc, as may be seen from the adjoining figure. The main current goes through *K*, *G*, *F*, *E*, *E'*, *F*, *G'* to the solenoids *N* and *P* and leaves the lamp through the terminal *K'*. In parallel with the incandescent body *E*, the two carbons *L* and L^2 are connected, which are bridged by a third carbon *L'*. The latter is connected with an iron core *M*. In general the spring *O* presses *M* and L^1 against *L* and L^2. When current is supplied to the solenoid *N*, the iron core is attracted and the carbon *L'* is removed from *L* and L^2, so that an arc is produced

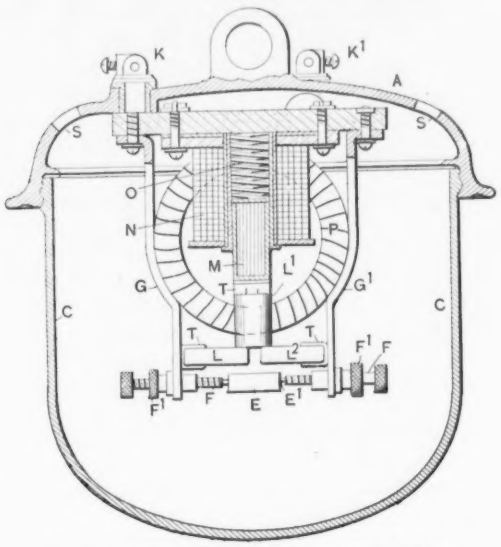


FIG. 2.—UNION ELECTRIC COMPANY LAMP.

which is blown by the solenoid *P* against the incandescent body *E*, which becomes a conductor. The current in both solenoids then increases so that when the iron core *M* is moved further into the solenoid *N* the arc is blown out by the solenoid *P*. In another lamp the heating is also produced by an arc and the heating current is interrupted by a thermostat. Finally a switch devised by Hirst is described; by a movement of a lever the incandescent body is connected to the circuit, by a further movement the heating body is also inserted into the circuit; when the incandescent body is heated sufficiently, the lever is released and brought back by a spring to that position in which only the incandescent body is connected to the circuit.—*Elek. Anz.*, Feb. 18.

Spectroscopic Arc Lamp.—FABRY and PEROT.—A French Acadamy note describing a lamp for spectroscopic work. They use an intermittent form of arc, which plays between two electrodes of the metal to be examined, one of which is provided with a mechanism which brings it into contact with the other and separates it in rapid succession, so as to produce an apparently continuous light. The rays thus produced are exceedingly fine and brilliant.—*Comptes Rendus*, Feb. 5; abstracted in Lond. *Elec.*, March 2.

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Photometry.—REED.—An account of the apparatus and methods used by the New Orleans Edison Company for testing incandescent lamps which have been used, such as cut-offs, renewals, etc., and for determining whether to use the lamps again or destroy them.—*Amer. Elec.*, March.

Nernst Light.—RUHNER.—A note describing experiments for the demonstration of the action of the Nernst lamp. The arrangement is in the main identical with Jablochkoff's, and is said to be well adapted for lecture experiments, but has no industrial value.—*Elek. Zeit.*, Jan. 18.

Incandescent Lamps.—RICHARD.—Descriptions of details and methods of manufacture taken from patent specifications.—*L'Eclairage Elec.*, Feb. 10.

POWER.

Gas Power for Electrical Plants.—KRONE.—A paper read before the Electrotechnical Society of Hanover. In order to compare the operating cost of steam and gas power, he makes a computation of the cost of steam power, both with and without condensation, including interest on cost of plant, depreciation and attendance; this estimate includes also the cost of the electric plant for an installation of 100-hp, with an equal amount as reserve. He finds that the cost of an electric hp-hour delivered to the distributing system is, for a non-condensing engine, 2.6 cents, and with condensation 2.4 cents. The economy to be effected by the use of gas only, affects the fuel portion of the charge, the cost of an electric hp-hour comes out 2.0 cents, which shows an economy of 16 per cent. over steam power. He also gives a description of the small German power plant at Clausthal. There are two gas generators of 100-hp each, and two gas engines of 70-hp each, operating normally at 140 revolutions per minute, but this speed can be increased about 15 per cent., when it is desired to charge the storage battery. Regulation is effected by varying the amount of the charge, the mixture remaining constant. A variation of 50 per cent. in the load produces less than 3 per cent. variation of speed. The gas engines are direct-connected to two continuous current dynamos, each of 46-kw, the three-wire system with 2×10 volts being used. During the year ending March, 1899, the average output was 707 watt-hours per kilogram of fuel, which corresponds to 2.32 lbs. of mixed coke and anthracite per electric hp-hour delivered to the circuit.—*Zeit. des Ver. Deut. Ing.*; abstracted in *Eng. Mag.*, March.

Steam and Gas Engines for Electrical Supply.—ADAMS.—An article showing that the electrical supply system for a large area, including one generating station and many substations, would be improved if equipped with gas producers and engines requiring only about two-thirds of the coal now consumed with steam boilers. He then discusses the system in which in the main plant gas is generated on a large scale and distributed through pipes to substations equipped with gas engines and dynamos. He then gives an estimate of the cost for a special case and finds that the first cost of the complete equipment with such a system is about the same as that of electric power transmission, but the latter is somewhat less efficient.—*Eng. Mag.*, March.

Long Distance Transmission.—BELL.—An article on the limit of power transmission in distance and voltage. The distance practically is a function of the price of fuel, and the voltage is in the main a function of the climate. The combination of circumstances necessary to make a very long range and extreme voltage feasible, consists of a good market, a very high price of coal, and a climate dry enough to make insulation easy; in a very dry climate for a working voltage one might safely go under existing conditions to 50,000 volts. He gives a numerical estimate of a scheme to transmit 1000-kw over a line 200 miles long with a loss of 10 per cent., and finds that a sale of 1000-hp at $100 per hp-year, would not only be enough for all the fixed expenses but pay interest on the stock and provide a liberal sinking fund. In Mexico and portions of South America conditions may exist which are favorable to such schemes.—*Elec. Rev.*, March 7.

TRACTION.

Three-phase Versus Continuous Current Railways.—E. K. SCOTT.—An illustrated communication referring to some remarks made in the discussion of the Brit. Inst. of Elec. Eng. on the Swiss trip (Digest, Feb. 24). He says that the gearing on the Jungfrau locomotive has perhaps at the first sight the appearance of being complicated, but, as a matter of fact, when the different parts of the gear are analyzed, a three-phase locomotive is found more than usually simple. The horse-power of each motor on the Jungfrau locomotive is about the same as of each of the continuous current motors on the Central London Railway locomotive, which are worked series-parallel, and have in bulk about as much resistance as the rheostatically controlled Jungfrau motors. It is a characteristic of three-phase motors that while in circuit their speed cannot exceed that of synchronism plus the slip of, say, 4 per cent.; they therefore constitute an excellent brake in themselves, and this has in no small degree influenced the adoption of three-phase traction. He gives side by side two diagrams showing an ordinary car wiring diagram, solenoid controller, for two 30-hp continuous-current motors, and the connections of the switch gear on the Jungfrau locomotive, which appears to be very simple. It stands to reason that a plain rheostatic switch without any magnetic blowout or series parallel connections should be much simpler. He especially looks upon the absence of any arc-suppressing device as a distinct advantage of the three-phase traction motor. Such arcing as does occur is at a low voltage and very feeble, due possibly to the short airgap of the motors and the fact that the magnetic circuit is built up wholly of soft steel plates like a transformer. The rheostatic method of control allows of an extremely regular, and, therefore, a rapid acceleration, and there is no liability to jerk, as is often the case in changing continuous motors from series to parallel and back again. In working railways by electricity it is

essential for keeping a good time schedule that the substations should be at very frequent intervals and the maximum speed as constant as possible. "Grant these, and the case for three-phase traction is strong indeed."—Lond. *Elec.*, Feb. 16.

Field.—An illustrated communication questioning whether it is practical to keep the maximum speed as constant as possible. He shows by diagrams that the tendency should be to obtain rapid accelerations up to the maximum speed, then to shut off the current completely, coast as far as possible, utilizing to the best advantage the kinetic energy of the train, so that when the brakes are applied the speed is comparatively small. In a numerical example he shows that the energy wasted in brakes is only one-ninth that at constant speed during nearly all times, with quick acceleration at the start and quick braking at the stop. Therefore the velocity time curve has to be peaked and not flat. A three-phase motor would be running continually very inefficiently. This argument, however, applies only to railways where a quick time schedule is required and the stations are very near together, and not to a mountain railway where the maximum speed is five miles per hour and where the distance between stations is one mile. The main point is that whereas on the Central London the accelerating forces are about twice those required for overcoming friction and gradients, and the acceleration lasts about one-third of the journey, on the mountain railway the accelerating force may be about one-eighth of the tractive effort required for friction and grades and is exerted for say 1-100th of the whole journey between stations. In the former case the acceleration is the all important point, in the latter it is the least important.—Lond. *Elec.*, Feb. 23.

Levin.—A communication pointing out that, given all reasonable foresight, it is still the unexpected that always happens and the advantage is with the system which is least likely to be deranged by conditions not foreseen in the design. It is here, he says, that the continuous current is superior to multiphase for working traction motors. He suggests increasing the tension on continuous current lines to 750 volts. This is based on the fact that multiphase lines have already been equipped for that voltage. An increase of voltage will reduce the amount of copper required in about equal proportion with either system, while with any given voltage, length between feeding points, and percentage loss, the advantage will be with continuous currents, owing to the fact that two out of the three conductors must be of copper for the three-phase line.—Lond. *Elec.*, Feb. 23.

An editorial on the same question. The conditions which obtain in existing three-phase railways are totally different in almost every respect from those in the Central London Railway and in other lines of the same type or in street tramway networks. The success of three-phase working on a simple track such as that at Lugano, does not point to the suitability of that system for town tramways or complicated networks. Besides the energy wasted in the brake, discussed in the communication of Field, the following two points are important in the question of the best form of the velocity curve: the maximum acceleration and braking rates which can be applied with comfort to the passengers, and the additional capital outlay on locomotive power plant involved by an increase in the acceleration. The irregular curve favored by the best locomotive practice makes it all the harder for three-phase engineers to adapt their system to these requirements.—Lond. *Elec.*, Feb. 23.

Scott.—A reply in which he explains what he means with the diagram in his first communication. The series-parallel continuous current control is a good thing for a street car which must be constantly stopped and started, but the necessity for it is not evident on an electric train which goes a long journey without a break. To the statement that we do not know enough of the cost of working three-phase lines, he replies that there is abundance of evidence that anything that is sound from an engineering and scientific point of view, will give satisfactory financial results.—Lond. *Elec.*, March 2.

London Railway.—Some notes on the recently opened extensions of the City & South London Railway. The original power station was shut down, and at the same time the new station started to operate the whole system. This change-over is of special interest, as the new plant works the railway on the three-wire continuous system, a rival to the system of three-phase transmission with continuous current on the trolley line, which is soon to be used on the Central London Railway. Besides the three working conductors, a fourth and fifth 500-volt conductor, each at 1000 volts above earth, but 500 volts above the neighboring feeder, are carried from the power station to a substation where there are motor generators which feed the line at 500 volts above earth. Another feature is the introduction of a three-wire accumulator battery. A detailed description of the system is promised.—Lond. *Elec.*, March 2.

London District Railways.—A note on a remark of the chairman of the Metropolitan District Railway, stating that a report has been submitted by Sir W. H. Preece and Sir J. W. Barry. Experiments have shown that better results can be obtained by using electricity instead of steam. More passengers can be carried with a given weight of rolling stock and at a smaller cost. No technical information is given.—Lond. *Elec. Eng.*, Feb. 23.

Substitution of Electric for Steam Traction.—An editorial discussion of the recent Institute paper by Boynton, which is also reprinted in condensed form in the same issue. It is remarked in the editorial that during the past five years the prophecies concerning the disappearance of the steam locomotive have been heard less frequently; it is thought that engineers of the present day have as a rule agreed that the movement of heavy trains by electric motive power is as visionary a dream as projects for mechanical flight, especially in heavy freight traffic, as the modern freight locomotive is one of the most economical and efficient machines in existence, and it is not thought that electric traction could even approach competition with it; the only debatable ground is that of local passenger service. The view is held that no hard and fast rules can be laid down concerning the advisability of changing from steam to electricity, as each case must be considered by itself, but it is thought that the probabilities are against profit in such a change. Electric propulsion is considered a mere incident in the competition, the principal advantage of electric cars being considered to be that they can pick up and leave their passengers along the streets, as distinguished from fixed stations; it is thought that steam railway companies could not obtain permission to do this. The present rates of speed must be maintained, and therefore the accepted safe practice in steam railway operation must be adhered to (referring to the block system). It is admitted to be an important item in favor of electricity that there can then be a more frequent train service, but this is thought to be more important in inter-city traffic than in suburban traffic; with the latter long trains during the rush hours would still have to be adopted and the intervals between these trains could not be much less than at present; the expected additional traffic would therefore be that obtained during the other hours, and it must be determined to what extent this traffic can be increased. The reduction in the output is briefly discussed; what appeals most forcibly to railway managers is the fact that a single car, or a motor car with trailer, would often be sufficient to carry the traffic when not dense. The question of the relative expenditures to operate and maintain two kinds of roads is considered to be of the least importance; the electric system involves a much greater investment; it has a considerable advantage in the item of repairs, but in fuel consumption both are on an equal footing owing to the loss in transmission and conversion in the electric system.—*Eng. News*, March 8. Boynton's paper is published in full in *St. R'y Jour.*, March, and in abstract in ***El'ty*, March 7.**

Electric Locomotives in Germany.—Tischbein.—An illustrated paper, read before the German Society of Mechanical Engineers. Electric locomotives are used in Germany as auxiliaries in connection with steam railways, for tunnels, private sections, train yards, etc. Their advantages are the absence of smoke, gas and noise, and the absence of reciprocating parts, and consequently freedom from vibration and hammer blows upon the rails. Either the trolley, or the accumulator, or a combined trolley and accumulator system are used; the third rail system has not yet been applied in Germany. The combined system is used in the locomotive for the Lagerhof-Gesundbrunnen branch railway operated in connection with the main line of the Prussian State Railways. The machine is of 300-hp capacity, the current being supplied by three overhead wires, double roller contact underrunning trolleys being used, while an auxiliary storage battery of sufficient capacity to operate the locomotive at full capacity for one-quarter-hour is provided in order to permit trains to be manipulated at the junction of the trolley and main roads. The pure accumulator system is used on locomotives in the sugar refinery at Noerten, their weight being 17 tons, and a battery capacity enabling them to be operated for an entire day without recharging.—*Glaser's Ann.*; abstracted in *Eng. Mag.*, March.

High Speed Railway.—An illustrated description of the high speed three-phase railway from Toledo to Norwalk, a distance of 60 miles, the current being supplied from a neighboring water power station 20 miles from each terminus. There are six substations where the three-phase current will be converted into direct current. The

equipment is similar to that on the Detroit railway, recently illustrated. Each 200-kw rotary converter at the substation has an induction motor for starting it.—*St. R'y Jour.,* March.

Metropolitan Company of New York.—A long illustrated article on the main power station and transmission system of this company. The total output of the station is 77,000-hp; 5 of the 11 units have been installed; the distribution voltage is 6600, which is transformed down to 500 volts direct current for use on the railway lines. The generators are said to be the most powerful in the world; they generate polyphase current at 25 cycles directly at 66,000 volts. There will be six substations. The mechanical engineering features are described at some length; also the switches and switchboard arrangements. The oil switches are quite different from those previously used, and they serve as switches, circuit breakers and fuses, being operated by compressed air, which in turn is controlled electrically from a distance. The step-down transformers deliver six-phase currents to the rotary converters, instead of three-phase, the object being to reduce the resistance losses in the armatures of the rotary converters, thereby raising their capacity with the same temperature rise. Each substation has a storage battery.—*St. R'y Jour.,* March.

Electric Automobiles in Chicago.—An illustrated article on the Illinois Electric Vehicle Transportation Company, which has been in operation for six months and has developed far beyond the expectations. When a cab returns to the station the battery is tested and recharged, which process is described. The battery of each hansom is a 48-cell Chloride accumulator, with a capacity of 100 amp.-hours for a 10 hours' discharge. Although there is but one tray, the battery is divided into two sections of 24 cells each, which allows a series or parallel arrangement. As the voltage of a discharged battery is considerably lower than that of the circuit on completion of the charge, two charging pressures at the switchboard are provided, one of 113 volts and the other of 120 to 125 volts. An exhausted battery is first thrown on to the low pressure busbars in circuit with 3 ohms of resistance, with a current of 35 to 40 amp. As the amperes fall the resistance is cut out gradually and finally, at about 10 amp., the circuit is thrown on to the high bus, with the full resistance, at about 30 amp. This resistance is cut out as before, when the battery is considered to be fully charged. To fully charge an exhausted battery in this way takes about four hours, although it can be charged in less time at a higher amperage, but with a corresponding loss in efficiency. There are three substations; the company uses also the public charging plugs of the Chicago Edison Company. It now has 72 vehicles. The rates for electric carriages have been reduced to less than those of horse cabs.—*West. Elec.,* March 10.

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Electric Traction in Moscow.—KRANNHALS.—An illustrated English abstract of the German article noticed in the Digest March 10.—Lond. *Elec.,* Feb. 23.

New England.—A description of the railway from Exeter to Amesbury, showing how it developed a pleasure traffic and describing elaborate provisions for extinguishing fires.—*St. R'y Jour.,* March.

Overhead Line Construction.—HERRICK.—A discussion of the construction of span and trolley wires accompanied by numerous illustrations of details; also a table showing the weights and breaking strains of galvanized steel span wire of different sizes. He describes methods of erecting such lines. Another table gives the allowable depth of a span wire in inches with different lengths of spans and strains.—*St. R'y Jour.,* March.

Construction of Overhead Equipments.—The first parts of an illustrated article, describing in detail the work of pole planting.—Lond. *Elec. Rev.,* Feb. 23, March 2.

Effect of Temperature in Overhead Railway Wires.—EISIG.—A French translation in abstract of the article noticed in the Digest Oct. 7.—*L'Elec.,* Feb. 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

London.—A very long well illustrated description of the City Road station of the County of London & Brush Provincial Electric Lighting Company. There are six steam driven 200-kw, two-phase, 50-period generators, and five steam driven 180-kw, single-phase, 100-period generators; the former are run in parallel with each other, the latter also. It is intended to extend the two-phase system over the whole area. To insure economy, until this is done, a motor generator is used for working either as a single-phase 2000 to 2200-volt, 100-period machine, or as a two-phase 2000 to 2200-volt, 50-period machine, according as a biphase or single-phase steam generator may be at work at the time of light load, thus providing for the running of one engine instead of two, while giving a single-phase supply to the older parts of the district and a two-phase supply to the later connected districts. There are also two steam driven 550-kw generators of the General Electric Company; also two alternating single-phase motor generators, coupled to two 75-kw, 550-volt, direct current machines, which have hitherto supplied the direct current for motors throughout a district; also a biphase, 50-period motor generator direct coupled to a direct current machine. A battery of 302 Tudor accumulators with a capacity of 595 kw-hours is run in parallel with the motor generators or with the railway generators during the day or by itself at night, for the supply of current to motors in printing houses, etc. During the year the maximum load on the station at any one time was 1290-kw. The yearly output is about 1,250,000 kw-hours.—Lond. *Elec. Eng.,* Feb. 23.

Alternating Current Plants.—A large folded table supplement giving a list of the 69 provincial and 10 London plants, using the high pressure alternating current system in the United Kingdom. The table gives the names of places, the lighting authority, the system of distribution, the numbers and types of boilers, engines or turbines and horse-power of each unit, the types and sizes of the generators, the system of driving, a remark whether condensing or non-condensing the systems of mains, the number of arc and incandescent lights in private and public lighting, the charge rates, the systems of charging, the types of meters used, the present actual capacity of the plants, ranging between 42 and 3154-kw, the nature of fuel used, the total cost of constructing and equipping works, the cost of mains, the annual revenue per 8-cp lamp, the number of high voltage lamps used, the periodicity (there are 17 different periodicities: 40, 50, 60, 66, 67, 67.5, 75, 77, 80, 83, 83.5, 87, 87.5, 90, 93, 100, 125), the declared pressure at consumers' terminals, the number and aggregate horse-power of motors connected and the names of the chief engineers. No summary is given.—Lond. *Elec. Rev.,* Feb. 23.

Water Power Plant.—A long well illustrated description of the small English water power plant for electric lighting of the village of Ingleton. There are two horizontal turbines developing from 15 to 20-hp, driving two continuous current dynamos which give either 45-amp at 250 volts or 35-amp at 330 volts, as required for charging the cells. The battery consists of 116 cells of 780 amp-hours' capacity. Distribution is effected on the three-wire system, by means of three-core, lead covered and armored cable. The system has been designed for 2000 lamps of 8-cp.—Lond. *Elec.,* Feb. 16.

Tamworth.—An illustrated article on the electric lighting system of Tamworth, New South Wales, situated about 268 miles north of Sydney. It is the first city in Australia which has adopted electricity for street lighting. The small plant was erected in 1888 and contains two dynamos, each giving 90-amp. at 230 volts. For lighting 11 miles of streets, covering an area of about 8 square miles, four arc lamps and 260 incandescent lamps of 16-cp are used. There is very little private lighting.—Lond. *Elec. Rev.,* Feb. 23.

Free Wiring System.—BROWN.—An account of "a year's experience of the free wiring system" in Lincoln. The principal points of the contracts are given between the Lincoln municipality, which supplies the electric light, and the wiring company which wires free of initial cost, the premises of any householder who desires to use electric light. For the use of the installation the wiring company charges the municipality the sum of 2 cents per kw-hour for all kw-hours used at the average maximum demand and 1 cent per kw for all used beyond. During the year 45 houses were connected out of a total of 185. The free wiring system enables a lighting company to reach houses occupied on short tenancies. It has the effect of stimulating competition among wiring contractors to canvass for consumers, and it enables all who wish to use electricity to do so on comparatively easy terms.—Lond. *Elec.,* Feb. 16.

REFERENCES.

Graphical Theory.—HANAPPE.—The beginning of a mathematical article apparently in the nature of a treatise on the subject, describing the application of the graphical theory to a study of the distribution systems with alternating and polyphase currents.—*L'Eclairage Elec.,* Feb. 17.

Alternating Low-Tension Central Station.—ZURFLUH.—A description of a small plant at Rockford, Ohio, distributing alternating current from an inductor generator at 220 volts, two-wire. The plant is used for lighting streets by means of 32-cp lamps.—*Amer. Elec.,* March.

A Railway Power Station in New York City.—A description of the steam equipment of the 70,000-hp central station of the Metropolitan Street Railway Company in New York City, previously noted in these columns.—*Amer. Elec.,* March.

Wires, Wiring and Conduits.

House Wiring.—De Segundo.—He considers wiring rules to be satisfactory but claims that there is an element of conscientiousness in the work which imperils safety. The inspection is based largely on nothing more than the insulation resistance, but there are many points which are not revealed by such a test. Rules can be enforced only by efficient superintendence during the execution of the work. He recommends avoiding all joints in the main and distributing circuits or else to have them all in one box in an accessible position. He recommends the subdivision of circuits protected by double pole fuses in easily accessible positions; the method of protecting wires from mechanical injury should admit of the wires being drawn in and out with as little trouble as possible.—Lond. *Elec. Rev.*, Feb. 23.

Aluminum Conductors.—Perkins.—An illustrated article describing the latest apparatus installed by the Pittsburg Reduction Company, and giving a comparison of aluminum and copper for electrical purposes including the relative costs. He discusses the effects of allowing also the use of aluminum for fire-alarm purposes, busbars in station work and for power transmission. The soldering of solid wire is not recommended. Small wires can be joined by twisting the ends around each other. Aluminum sleeve joints are made either of tubes or rolled sheet. They possess mechanical strength equal to the wire itself, and the conductivity is equal to that of an equal length of the wire. Cables are best joined by soldering the ends in brass or aluminum sleeves, as is done with copper cables. Finally, he discusses briefly the effects due to self-induction, capacity and the skin effect in aluminum wires.—*West. Elec.,* March 10.

REFERENCES.

Interior Wiring. —Knox.—The continuation of the serial on this topic, taking up the subject of the switchboards. Working drawings and a connection diagram are given for an isolated plant board designed for three dynamos, two of 50-kw and one of 25-kw capacity with power and lighting buses.—*Amer. Elec.,* March.

Electro-Physics and Magnetism.

Molecular Changes Produced by Electric Waves.—Bose.—A very long illustrated abstract of a Royal Society paper, giving an account of a continuation of his researches on coherer action, noticed in the Digest Aug. 12. He had found that electric waves produce either an increase or a diminution of resistance, depending on the nature of the substance. He calls this effect a positive or negative "electric touch," and calls substances positive when the electric oscillation produces an increase of conductivity, and negative when a diminution of conductivity. He endeavors to reduce the very anomalous action of contact-sensitiveness of metals to a systematic behavior, of finding out the different causes which are instrumental in producing the observed effect. He sums up his results as follows: ether waves produce molecular changes in matter; molecular or allotropic changes are attended with changes of electric conductivity, and this explains the action of the so-called coherers; the production of an allotropic modification depends on the intensity and duration of incident electric radiation; the continuous action of radiation produces oscillatory changes in the molecular structure; these periodic changes are evidenced by the corresponding electric reversals; the "fatigue" is due to the presence of the "radiation product;" by means of mechanical disturbance or heat the radiation product can be transformed into the normal form, and by so doing the sensitiveness may be restored. The varieties of phenomena are unlimited, as in each substance account is to be taken of the peculiarity of its chemical nature, the nature of its response to ether waves, the lag, and the molecular viscosity. All these combined give to each substance its peculiar characteristic curve. Some of the types of these curves are reproduced. He remarks that possibly in a humbler way these curves of substances in the solid state will some day be found to give information as to the chemical nature and the physical condition of the substance, similar to the information given by spectrum analysis of substances in the gaseous state.—Lond. *Elec.,* Feb. 23, March 2.

Specific Electric Strength.—Orgler.—A paper calling attention to the fact that the electric strength of a gas, as defined by Maxwell as the e. m. f. at the instant of discharge, is not a true constant for any given gas, neither is the "specific electric strength," if defined as the spark potential in any gas referred to air under the same conditions. He proposes another definition, which leads to a quantity truly characteristic for each gas and independent of the pressure and the width of the gap. He divides the e. m. f. required to bridge the gap into two parts, one of which overcomes the transition resistance at the surface of the electrodes, while the other perforates the gas itself. Since the former is independent of the width of the gap, it can be eliminated by differentiation. He defines specific electric strength as the ratio of the differential coefficients in gas and air respectively, with respect to the width of the gap. It is 1 for air, 1.050 for nitrogen, 0.888 for carbonic acid and oxygen and 0.563 for hydrogen.—*Ann. der Physik,* January; abstracted in Lond. *Elec.,* Feb. 16.

Transmission of Electricity Through Air at High Temperature.—Khessin.—A Russian Physical-Chemical Society paper. Two electrodes of platinum were placed in a porcelain tube heated to over 1000° C. The conductivity increased very rapidly with the temperature but it diminished with an increase of the e. m. f.; the maximum corresponded to a distance of two millimeters between the electrodes. With a diffused discharge the negative electricity passed more freely than the postive, at temperatures below 1000°, but the reverse was the case at temperatures exceeding 1050° C.—*Jour. de la Soc. Physico-Chimique Russe,* Vol. 31, abstracted in *L'Eclairage Elec.,* Feb. 3.

Polonium Rays.—S. Curie.—An account of an investigation of the penetrative power of polonium rays. With Röntgen rays the absorption weeds out all but the rays of greatest penetrative power, but with polonium rays it is just the contrary. Polonium rays do not penetrate the air at ordinary pressures farther than about 1½ inches, or about the same distance as Leonard rays; those radium rays which are not deflected by a magnet behave exactly like polonium rays. It is difficult to discover any law of absorption in radium rays by themselves, as they consist of two species of rays obeying different laws of absorption. It is possible that these different laws indicate a fundamental difference in the nature of the deflected and undeflected rays.—*Comptes Rendus,* Jan. 8; abstracted in Lond. *Elec.,* Feb. 23.

Mechanical Actions of a Crooke's X-Ray Tube.—Michkine.—A Russian Physical-Chemical Soc. paper. A light magnetic needle placed in the field of a Crooke's tube will take a position parallel to a line joining the electrodes; the same is true of a needle of non-magnetic material or a dielectric. One of larger dimensions will start to turn if it is given a slight impulse; it will turn in either direction but with different velocities. A thin celluloid disc on a pivot affords a simple and convenient means for exploring the field of a Crooke's tube. Some conclusions thus arrived at concerning the field are given.—*Jour. de la Soc. Physico-Chimique Russe,* Vol. 31; abstracted in *L'Eclairage Elec.,* Feb. 3.

Zeeman Effect.—Zeeman.—An account of observations of some asymmetries in the Zeeman effect. He has confirmed the deduction of Voigt that normal triplets show in weak magnetic fields a greater intensity in the outer component towards the red, and a greater distance of the outer component towards the violet. He considers that these asymmetries do not decide the relative merits of Voigt's and Lorenz's theories, but confirm the common basis of both.—*Proc. Akad. Amsterdam,* Dec. 30; abstracted in Lond. *Elec.,* Feb. 16.

Magnetic Viscosity.—Lizzie Laird.—An account of an experimental investigation. In the numerical determination of the magnetic after effect, namely, that iron introduced into a feeble magnetic field does not at once assume the magnetic intensity corresponding to the field—there is a difficulty in the determination of the initial value of the magnetic intensity. It is overcome by keeping a disc of the metal in question, rotating. To follow the course of the after effect in time, she used a system of photographic registration. In the particular case investigated the final state of eqpilibruim was attained in 12 seconds, during which the intensity rose from 87 to 100 per cent. and the susceptibility from 57 to 100 per cent. of its final value. —*Ann. der Physik,* January; abstracted in Lond. *Elec.,* Feb. 16.

Molecular Susceptibilities.—Liebknecht, Wills and Dubois.—An account of an investigation of the molecular susceptibilities of the elements of the iron group and of the rare earthy elements. In the former group there is a sudden rise from chromium to manganese and ferric iron, and a gradual fall from the latter to cobalt, nickel and copper. In the rare earths there is a gradual rise from cerium to praseodymium and neodymium; a decided rise in samarium, gadolinium and erbium; and a sudden fall to ytterbium at the end of the series. Slight admixtures of any of these to iron may lead to surprising results.—*Ann. der Physik,* January; abstracted in Lond. *Elec.,* Feb. 16.

Relations Between Magnetization and Other Phenomena.—MAURAIN.—A short article giving a summary and analysis of, and a large number of references to the literature on this subject. He discusses such subjects as the mechanical actions, dimensions and volume, Hall phenomena, specific inductive power, etc. What is known about magnetization leads one to believe that whatever may be the precise cause, it modifies the relations between the molecules, probably without altering the molecules themselves. It follows that it ought not to modify the properties depending on the molecules themselves, such as the molecular weight, density, specific heat, etc., while it could have an effect on those properties which depend upon the relative positions of the molecules, such as electric or thermo-conductivity, mechanical properties, dimensions, etc. This corresponds to the results of his searches up to the present time.—*L'Eclairage Elec.*, Feb. 10.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemistry.—KINGMAN.—The first part of an illustrated paper read before the Chicago Electrical Association, on recent progress in electrochemistry. He gives an outline of the present theory of electrochemistry, as developed by Arrhenius, Van't Hoff, Nernst and Oswald, and describes the application of electricity to the manufacture of chemicals, both organic and inorganic. In the present part the processes for the production of caustic soda and bleaching powder are described.—*West. Elec.*, March 10.

Electrolysis of Common Salt.—HOBART.—The beginning of a general account of the means of producing soda and chlorine from common salt. The first installment of the article takes up in an elementary way the chemical reaction.—*Amer. Elec.*, March.

Auxiliary Telephone Circuit.—KRAHMER.—A short illustrated article in which he calls attention to the fact that the usual series method of connecting an extension desk set No. 2 to the wall instrument No. 1, has the disadvantages that a party using instrument No. 2 has to talk through the ringer coils of No. 1, the resistance of which may be from 80 to 1600 ohms, and that if No. 2 rings central, he also rings the bells of No. 1. He proposes instead another arrangement which is illustrated in a diagram. When No. 1 is used, the party talks through instrument No. 2, but as this has a shunted generator, there is no resistance. If No. 2 calls central he cuts out instrument No. 1 by means of a strap key, but only while he is ringing. As soon as he takes the receiver off the hook, the circuit of instrument No. 1 is opened.—*Tel. Mag.*, February.

REFERENCE.

Selective Telephone Signals.—WEBB.—An account of the work of selective telephone signaling systems patented by Mr. Barrett and used to a certain extent by the American Bell Telephone Company. This article is similar to that published a month before and describes the automatic secrecy or locking out device.—*Amer. Elec.*, March.

MISCELLANEOUS.

Annealing Armor Plates.—DOUGHERTY.—A paper read before the Engineers' Club of Philadelphia on the electrical method in use industrially in the construction of warships by the Cramp Company. The process appears to be precisely the same as described in an Institute paper by Lemp in 1895, and consists in using a transformer similar to those used for welding, by means of which a strong current is passed through the metal where the hole is to be drilled, and then diminishing the current gradually during 10 to 20 minutes, which anneals that spot. One of the interesting features in the paper is that it shows that this method has proved itself to be successful industrially. The secondary current is about 10,000 amperes at 2.5 to 2.8 volts; the contact surfaces are only about half a square inch, which means a current density of 40,000 amperes per square inch; the total weight of the transformer, which is about 1000 pounds, is sufficient to make good contact; the space to be drilled lies midway between the two contacts. A curious feature is that the motor and generator are transported with the building containing them, to the work, in preference to running wires from the stationary plant; four wires are required, two of them being for regulating the field of the generator by means of which the secondary current is adjusted. The process has been used for the plates of the Alabama. The Harveyized plates are now being superseded by the Krupp plates which are hardened to a depth of two inches instead of less than one, but nevertheless the electric method is found to answer very well for these also. In the discussion it is suggested that a much simpler way of regulating the current and enabling a stationary plant to be used, would be to regulate the primary current at the transformer by means of choking coils.—*Proc. Engineers' Club of Philadelphia*, February.

Gutta Percha.—HILL.—An article giving data concerning Pacific and Atlantic cables, the sources of supply of gutta percha, the methods of collecting, the demand and the attempts at culture. The belief prevails in some quarters that gutta percha exists in the Philippines, although the conditions favorable to its occurrence do not lend much strength to this belief.—*Elec. Rev.*, March 7.

Italy.—BIGNAMI.—An article on the electrical progress in Italy during 1899. The Como Electrical Exposition is noticed. The capital invested in electrical industry is now about $600,000. Electric railways and power transmision plants are increasing. An invention is mentioned made by Prof. Mario Russo d'Azar, who recently made experiments with wireless telephony between two trains under way; the results are said to have been excellent, but no technical information is given.—*Elec. Rev.*, March 7.

South America.—KING.—The first part of an article on the status of the electrical industry in South America. At present nearly all of the large towns and cities of the South American republics are either lighted by electricity or have projects under consideration. Many of the tramway companies have changed their "burro" traction lines to the electric system. Many of these companies are composed of American capitalists. Argentina, Brazil and Chili are the most advanced in electrical work; Uruguay, Paraguay and Venezuela come next. A review of the work in Argentina, Uruguay and Brazil is given.—*Elec. Rev.*, March 7.

REFERENCE.

Copper.—HATCH.—The first part of a long illustrated statistical article on the world's supply of copper. He gives tables of the world's production and consumption of copper in the last ten year's, the position of public stocks for ten years, the average price for twelve years, the consumption of raw copper during five years in different countries, the production of fine copper for 1898 in various countries, the copper production of the United States from 1845 to 1898, and the output of the several states. The output of the following states is then outlined with illustrations of plants: Montana, Michigan, Arizona, California, Colorado and Utah, Eastern and Southern States, Spain and Portugal, Japan.—*Eng. Mag.*, March.

New Books.

ELECTRIC WIRING. By Cecil P. Poole. New York: Power Publishing Company. 101 pages, 46 illustrations. Price, $1.00.

This useful little book assumes on the part of the reader for its understanding merely familiarity with Ohm's law, and is designed to serve both as instruction for practical wiremen and as a convenience and general reference book for electrical engineers. A valuable feature for practical men who have not had the advantage of an academic education is an introductory chapter in which the elements of algebra are explained. A careful study of this chapter should enable any intelligent wireman to apply the simple formulas given throughout the book. All of the commonly used circuits for interior wiring are explained and methods and tables are given for the calculation of the conductors. All the tables have been specially prepared by the author for this book and most of them have been calculated and arranged in a more convenient manner than the usual wiring tables. The instructions relating to three-wire circuits and wiring installations in buildings of several floors are unusually complete, and the tables for laying out continuous-current motor circuits are more elaborate than those usually given.

One chapter is devoted to alternating-current wiring, in the calculation of which inductance is taken into account. The methods here given are probably the simplest and most easily understood that have yet been offered for the calculation of alternating-current conductors, and the treatment of alternating-current circuits is unusually complete. Tables are given which enable the reader to make corrections in the drop with reference to the inductive effect; these tables include secondary circuits carrying non-inductive loads, primary circuits for incandescent lighting, and primary power circuits having power factors of .80, .87, .89 and 92. The chapter also contains data and tables for single-phase, two-phase and three-phase alternating-current motor lines of all of the commercial voltages. Following the chapter on alternating-current wiring there is a chapter on aluminum wires and a final chapter giving numerous diagrams of connections,

including switch arrangements for controlling lamps from two or more points independently, diagrams of alternating-current motor and transformer connections, and a number of diagrams of electric bell circuits. An appendix is added which contains a large number of wiring formulas, most of them relating to alternating-current circuits. These formulas are intended primarily for the convenience of technical engineers whose work includes the laying out of transmission circuits, etc.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, April 6. Paper, "Laboratory Methods," by Prof. Irwin J. Macomber.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York. Next meeting, March 28. Paper: "The Evolution of a Safe and Accurate Protective Fuse," by Joseph Sachs.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

NEW YORK ELECTRICAL SOCIETY. Next meeting, March 22, College of the City of New York. Subject of discussion: "Status of Automobile Development To-day," by A. L. Riker, C. J. Field and J. A. Kingman.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Detroit, Mich., June 20, 1900.

FRANKLIN INSTITUTE, Philadelphia, Electrical Section. Next meeting, March 27. Paper, "Fire Alarm Telegraphs," by Mr. Adam Bosch, Newark, N. J.

New Navy Standard Projectors.

The recent large increase in the navies of the world has created a very large demand for electrical apparatus of all kinds, particularly for projectors, generating machinery, etc. The navy specifications require apparatus different in many respects from that found best suited for commercial used, and in most cases require special designs throughout.

Among the concerns making a specialty of naval apparatus is the Rushmore Dynamo Works, of Jersey City, N. J., at which are now being built a large number of all sizes of projectors for use on warships. The illustration herewith shows one of the new Rushmore 18-inch 35-ampere navy standard projectors being built for the torpedo-boat destroyers and other vessels, quite a number of which are already in service. These projectors are equipped with extremely efficient parabolic lenses, for the making of which the company has a most complete lens plant. The lenses are of uniform thickness, and are thus very much lighter than the Mangin type. The cylinder of the light is fitted with sliding bearings so that it may be readily balanced as required by the navy when used with the heavier Mangin lens.

Each projector is supplied with a front door fitted with plain glass strips, and also an extra front door fitted with the navy standard diverging lens strips, which are also made in large quantities at the works. The lamp movement is the latest Rushmore positive feed type, and will feed the carbons both toward and away from each other, as required to keep the arc absolutely constant at 50 volts, the variation under the most extreme conditions being less than one volt. In all other lamps heretofore used in the navy the carbons are separated a definite amount by a series magnet, and as they are consumed are fed together by a separate shunt magnet. Should the wind or a defect in the carbons cause a displacement of the arc, the old lamps always overfeed and the lamp goes out until the carbons are separated by hand. This defect may lead to disaster in time of war, especially in the case of distant-control projectors. By pressing a small hand wheel into engagement, the automatic feed is thrown out of action and the lamp may be fed by hand, or the hand feed may be used in connection with the automatic feed.

The cylinder is fitted with two dark glass peep sights, one in the side for observing the arc in horizontal plane, and the other in the side of the top ventilator in connection with a prism for observing the arc in vertical plane. The turntable is mounted on roller bearings and moves very easily. There is provided a hand wheel for slow control vertical movement and another for slow horizontal control, these devices being readily locked in any position or instantly thrown out of engagement. There is a water-tight double-pole switch in the base. There is furnished a navy standard regulating rheostat for working on the 80-volt circuit with which the current may be varied from 20 to 35 amperes.

Direct-Connected Exhaust Fan with Detachable Motor.

The Triumph exhaust fan of the Specialty Manufacturing Company, of Indianapolis, Ind., formerly made for belted service, is now furnished direct-connected with detachable motor, as shown in the accompanying illustration. The flat square back of the belted fan, which afforded such convenience in installation, is utilized in the direct-connected fan. The manufacturers have carefully followed throughout the idea of convenient installation in designing the direct-connected fan, the motor being detachable and entirely separate. The bracket or motor support is a part of the fan frame.

In installing, the square frame is lagged or bolted to the opening; the motor is then placed on the bracket, to which it is firmly and securely held by cap screws; the fan wing is then secured to the shaft, and with the motor is connected up, the fan then being ready for operation. The detachable feature offers a number of advantages. For instance, it admits of a temporary use for other purposes

NAVY PROJECTOR.

EXHAUST FAN.

of the motor, which is easily detached, and can be set up where desired. With the fan wing removed and a pulley placed on the shaft instead, the motor may be used for belted service. As at certain seasons of the year fan service is not necessary, at such times the motor may be removed and utilized as above suggested.

The motors are of the most approved electrical and mechanical construction, and will run the fan at full speed without injurious heating, and without sparking at the brushes. As shown by the cut, the motor is of the enclosed type, thus affording ample protection against the accumulation of dirt and consequent damage, which has often been a source of great annoyance to the user of direct-connected fans, and a forcible argument against their employment.

The rheostat furnished with the motor is fireproof and supplied with automatic release. Carbon brushes are used and are provided with automatic feed. The bearings of these machines are interchangeable and self-oiling. As the machines are accurately balanced, there is practically no vibration when the fan is in operation. The distance between the motor and frame is reduced to a minimum, thus causing the motor to protrude the least possible in a room, and hence obviating the unsightly appearance so common with many fans of this class.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The general feeling in stock trading during the week was one of dullness, activity being confined to spots and a few specialties, notably Third Avenue Railway. Little attention was paid to the continued good railroad earnings and the favorable reports concerning industrial properties. The dullness, however, had its benefits, relief of the pressure on the money market being one of the results. In the traction group the chief movement was in Third Avenue, which developed great strength during the middle of the week, rising from around 50 to 70. The report of temporary Receiver Grant (summarized in this department), which was filed on March 15, was followed by an advance in the price of the stock. There was more or less pressure at times in Metropolitan Street Railway and Brooklyn Rapid Transit, and these stocks were generally weak. The tractions seemed to be generally affected by the franchise tax possibilities. Industrial stocks were generally heavy, although except in a few instances no particular selling pressure was manifest. The transactions in the regular list of electric and electric railway stocks for the week were as follows: The sales of Brooklyn Rapid Transit were 131,840 shares at prices ranging from 66½ to 70⅜, the closing quotation being 66⅞. These figures represent a net loss of ⅜ as compared with the prices of the week previous. Metropolitan Street Railway fluctuated between 160½ and 167, closing at 161, a net loss of 3½ points. The week's sales amounted to 51,082 shares. The transactions in Third Avenue were large, the sales being 216,833 shares. The quotations of the stock varied widely, the lowest price of the week being 55½ and the highest 71½, the closing quotation being 68¼. The net result was a gain of 11¾ points. General Electric received little attention, only 970 shares having changed hands during the week. The price was comparatively steady, ranging between 125¾ and 126⅞, the closing figure being 126, a net gain of 1. Western Union Telegraph closed the week with a net gain of 1 point, the quotations fluctuating between 82½ and 84, and closing at the latter figure. The transactions were 4502 shares. Among the outside securities Electric Boat, common was in good demand, sales being recorded at 17 and 18, a gain of 1 per cent. Three hundred shares of General Carriage changed hands at 7⅛, a gain of ¼ per cent. In Boston, Bell Telephone was steady at 315; Mexican Tel., 2¾-3; Westinghouse, common, 41½-45½; Westinghouse, preferred, 63; West End Street Railway, common, 95; West End Street Railway, preferred, 113. Closing prices of electrics in Philadelphia were: Electric Storage Battery, common, 80-85; General Electric Automobile, 2; Union Traction, 37.

VEHICLE AND STORAGE BATTERY COMPANIES.—A number of electrical corporations have recently been the subject of paragraphs in financial papers, according to which the several companies to which reference is made have had a trying time in the stock market within the past six months, it being stated that the value of their securities has shrunk more than $18,000,000. The companies named are the New England Electric Vehicle Transportation Company, the Illinois Electric Vehicle Transportation Company, the New York Electric Vehicle Transportation Company, the Electric Boat Company, the Electric Vehicle Company, the Electric Storage Battery Company and the Electric Axle, Light & Power Company. It is also stated that these companies have been over-capitalized, and in this connection it is mentioned that the New England Vehicle Transportation Company has reduced its capital (as was announced in our issue of last week) from $25,000,000 to $5,000,000. That there has been considerable shrinkage in the value of the securities of some of the companies mentioned, calculated on the basis of the highest and lowest quotations of stock, is true. This shrinkage, however, can be readily explained as the result of natural causes, last year having been a period of undue inflation during which stocks, not only of the vehicle, but of many other corporations, sold much beyond their actual value and dropped with the general reaction. The present status of the companies named appears to be as follows: The Electric Vehicle Company is the parent of the New York Electric Vehicle Transportation Company, the New England Electric Vehicle Transportation Company, the Pennsylvania Electric Vehicle Company and the Illinois Electric Vehicle Transportation Company. The capitalization of the Electric Vehicle Company is $12,000,000 ($5,000,000 preferred and $7,000,000 common). Five million dollars in cash were paid in; and the cash assets now on hand are rated at over $5,000,000. While the New York Electric Vehicle Transportation Company is capitalized at $25,000,000, the whole amount of stock has been actually subscribed for, and an assessment of 10 per cent. paid in cash. The same remark applies to the other electric vehicle transportation companies as originally organized, the stock, of course, having been made assessable up to 100 per cent. Recently, however, the New England Electric Vehicle Transportation Company cut down its capital stock to $5,000,000 in order to make it fully paid up and non-assessable. At the time the company was incorporated it was believed that it could use $25,000,000, but it has been found unnecessary to have so large a capital; $2,500,000 have been paid in; the other $2,500,000 of stock, with par of $10, will be in the treasury. In the case of the Illinois Electric Vehicle Transportation Company $2,500,000 were paid on first assessment in cash, and the capital stock has been reduced to $2,500,000 to make it a fully paid up and non-assessable stock, with a par value of $10. Another vehicle company recently organized is the Washington Electric Vehicle Transportation Company, with a capital of $500,000. The stock will be issued for cash at par and fully paid up. The Electric Axle, Light & Power Company mentioned no longer exists, having been absorbed by the Consolidated Train Lighting Company, which is controlled by Mr. Isaac L. Rice, who is also president of the Electric Boat Company. The Electric Storage Battery Company was capitalized for $18,000,000, and $16,000,000 of the stock have been subscribed for and issued. As the stock is now selling on the market for $90, the company can hardly be called overcapitalized.

BUSINESS PROFITS.—Some interesting figures have recently been published by a financial authority in regard to profits obtained in general business during the past year. They were made up by a bank and were based on returns made by sixty houses in fifteen trades in fourteen states. These firms had an aggregate capital of $122,432,000, an average of $2,156,000 for each firm. Their net profits last year amounted to $35,225,000, an average of $617,000 for each firm, or 28.6 per cent. A comparison of returns made by a large number of houses, while not in sufficient detail to enable an exact exhibit to be made, indicated a very general average profit last year in excess of 15 per cent. on the capital employed. This is of value, as showing the prosperity of the country, the increase in the investment fund and something of the condition of fairly capitalized and well managed industrial corporations. Assuming that well managed concerns earned last year an average of something like 20 per cent. on their capital, it follows that industrial combinations with preferred stock representing about the value of the property could earn 7 per cent. on the preferred and the substantial dividends which have been reported in quite a number of cases as having been earned on the common. It is an argument of considerable weight in favor of industrial preferred stocks, especially where the value of the plant is known with approximate certainty.

WESTERN UNION.—At a special meeting of the stockholders of the Western Union Telegraph Company the proposed issue of $20,000,000 4½ per cent. refunding 50-year bonds was ratified by a two-thirds vote. Less than $7,000,000 of the issue will be needed in order to retire old bonds, and it is supposed that only $3,000,000 will be necessary for renewals to the present property in the way of copper wire and poles. It has been rumored that there was a possibility of the company's utilizing the remaining $10,000,000 for the purpose of engaging in the telephone business, but the directors of the company deny that the subject has been discussed. The company's earnings for the quarter ending March 31, partly estimated, were reported as follows: Net revenue, $1,250,000; increase, $20,429; interest on bonds and sinking fund, $234,111; increase, $9,839; balance, $1,015,889; increase, $10,599; dividends, $1,216,997; deficit, $201,108, a decrease, compared with the deficit for the corresponding quarter of last year of $10,580. The previous surplus was $8,430,753, and after the payment of the dividend it will be $8,229,645. The regular quarterly dividend of 1¼ per cent. was declared, payable April 16.

CHICAGO TELEPHONE.—The Chicago Telephone Company on March 13 declared a cash dividend for the first quarter and a stock dividend of $1,000,000, both payable April 10. Stockholders will be privileged to subscribe for $500,000 additional shares at par. The market price is about $225. A second issue of $500,000 of new stock at par will be made next October. The Chicago Telephone Company was organized in 1881 with a capital stock of $500,000. It has been increased from time to time in new issues to stockholders at par until the present capital is $6,000,000, nearly all of which is outstanding. For years the company has paid 12 per cent. per annum in monthly payments, but with the declaration of the last dividend the period has been changed to quarterly. At the

beginning of 1899 the company was operating 21,876 telephones, of which 17,514 were in the Chicago Exchange. In the year 1898 the company showed a surplus after dividends of $113,572.

DIVIDENDS.—The Twin City Rapid Transit Company has declared a quarterly dividend on the preferred stock of 1¾ per cent., payable April 2. The directors of the Hall Signal Company have declared a dividend of 6 per cent. on the preferred stock and 1 per cent. on the common, payable April 2. The Boston Elevated Railway Company will pay on April 3 a dividend of $1.75 a share on the stock of the West End Street Railway Company. The Manhattan Railway Company has declared a quarterly dividend of 1 per cent., payable April 20. The Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent. The Otis Elevator Company has declared a quarterly dividend of 1½ per cent. on its preferred stock, payable April 14.

RECEIVER GRANT'S REPORT.—The report of temporary Receiver Grant of the Third Avenue Railroad, showing the financial condition of the properties, was filed on March 14. The report shows total liabilities of $24,871,917.99; contingent liabilities, $11,724,447.69; accounts receivable, $5,400,786.22; accounts payable, $837,220.82. Other items of assets: Assessed value of real estate, $2,881,000; rolling stock, machinery, etc., $1,591,531.59; other material and supplies, $322,999.88; cash, $22,789.94. The total amount of unsecured loans is $8,365,000, with accrued interest of $140,147.12. The total liabilities of the subsidiary roads is put at $30,683,298, much of this, however, being an asset of the Third Avenue Company.

A MILLION DOLLAR MORTGAGE.—The Rochester Gas & Electric Company has given a mortgage for $1,000,000 to the Security Trust Company of that city to secure $1,000,000 of 4½ per cent. gold bonds designed to refund $300,000 of 5 per cent. second mortgage bonds, maturing on March 15, 1902, and to provide for the extension of the company's plant. The bonds are for $1,000 each, with interest payable March 15 and September 16. The company reserves the right to retire any or all of the bonds on March 15, 1910, or on any other semi-annual interest day.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has increased its capital stock to $750,000, and made extensive purchases of land at Pittsburg, Pa., where it will start a branch. The company has already placed orders for the greater portion of its machinery equipment, and is now at work on the plans for the buildings, which will be quite extensive, and designed and built at the East Berlin shops. It is intended that this plant shall be fully equipped with all the modern appliances for doing all classes of steel bridges and structural work, the intention being to make the plant the best of the kind in this country.

BROOKLYN HEIGHTS' REPORT.—The statement of the Brooklyn Heights Railway for the quarter ended December 31 last shows a surplus after charges of $17,052, against a deficit of $368,629 for the corresponding period last year. The gross earnings for the quarter show an increase of $230,824 and the operating expenses a decrease of $95,976, bringing the increase in net to $326,800. The increase in other income of $13,037 brings the gain in the total net to $339,837. The fixed charges and taxes decreased $45,845, which makes the gain in surplus $385,681.

EXCHANGE OF BELL STOCK.—The Boston *Herald* says: "It is understood that the Bell Telephone Company will make known the plan of exchange of stock for long-distance stock at the annual meeting March 27 and will further announce a plan to give Bell holders something in addition to two shares of long distance stock, to-wit, an interest in valuable treasury assets not turned over to the long-distance company."

THE IMPERIAL ELECTRIC LIGHT, HEAT & POWER CO., of St. Louis, Mo., has voted to increase its capital stock from $200,000 to $1,500,000. The increase is for the purpose of extending the plant. It is said that the company will make a strong bid for city lighting contracts, and is preparing for the extension of its system to meet the requirements of such contracts should the company be successful bidders.

THE NEW ORLEANS TRACTION RAILROAD reports gross earnings for February of $111,024, an increase of $3816, as compared with the same month of last year, and net $44,239, a decrease of $3267. For the two months ending February 28 the gross earnings were $220,971, an increase of $3733, as compared with the corresponding period of last year, and net $86,944, a decrease of $5511.

ELECTRICITY IN GERMANY.—Consul General Guenther, of Frankfort, states that the new corporations in Germany in 1899 were 364, with a nominal capital of $129,600,000. The specifically electrical concerns had $8,200,000 capital; machinery, $26,000,000; railroads, $17,000,000. Somehow these figures look very small to an American eye.

INCREASING ITS STOCK.—The Bell Telephone Company of Philadelphia has voted to increase its capital stock from $4,000,000 to $6,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade advices as received through recognized channels indicate that in general the strength of values is apparently unabated, and the feeling is generally cheerful. The only exception is the situation in Chicago, where the strikes continue and where 54,000 men are now idle. Trade in that city and vicinity is consequently seriously affected. In other centres conditions are reported very satisfactory. Dun's reports state that the report of foreign commerce in February was surprisingly satisfactory. Though the month was short, the exports have been exceeded in only six months in the history of the country, and in daily average—$4,277,349—never surpassed except in December, 1898, with $4,446,793, and November, 1898, with $4,326,599. The excess of exports over imports—$50,991,612—raises the balance due this country on merchandise account to $364,803,464 for eight months. In March exports from New York have been $28,814,161, against $17,867,662 last year, promising another extraordinary month, as the imports here show a decrease of 15 per cent. Bradstreet's emphasizes the fact that there has been an increase in strength of values of farm products, while materials for manufacture and the products thereof have generally remained steady and unchanged. The copper market showed much more strength, accompanied by a better tone and a slight advance in price. Merchants report a very good business in this metal. A big foreign demand is reported. A sale of 1000 tons, or 2,240,000 pounds, of copper on a German order was made in New York on Tuesday. It was reported in the trade that the British Admiralty also closed a contract last week for 1000 tons, delivery to be made at once. Lake copper is quoted at 16½c; electrolytic in cakes, wire bars and ingots at 16¼-16⅜c, in cathodes at 16-16⅛c, and casting copper at 16¼c. The London market fluctuated considerably throughout the week, closing at a decline, and quoting £75 5s for spot and £74 5s for three months' futures. Best selected is unchanged at £78 10s. The iron and steel markets, though quiet, are rather more confident in tone. By the taking of orders for Bessemer pig at Pittsburg last week the entire production for the first half of the year in that district has been placed. Structural material is in better demand and some very large contracts will be placed shortly. Bradstreet's reports the number of failures for the week 190 against 189 last week and 205 the corresponding week last year. R. G. Dun & Co. compute the liabilities of the concerns failing for the two weeks of March at $6,206,491, against $4,916,226 as compared with the corresponding period last year.

PURCHASES OF MACHINERY.—Electrical manufacturing concerns continue to be good customers of manufacturers of machine tools, particularly electric vehicle companies. The Riker Electric Vehicle Company, of Elizabethport, N. J., is getting in a fine equipment of new tools and is constantly purchasing. The Automobile Company of America, whose plant is located at Marion, N. J., has recently purchased a large complement of machinery and is still in the market in a small way. The Bunnell Telegraph & Electrical Company, of New York, has been purchasing an outfit of small tools, including lathes, drill presses, screw machines, milling machines, etc. In other machinery lines activity seems to characterize business, in spite of advancing prices. The Harrisburg Foundry & Machine Company has been booking increased orders. A new advance, varying from 5 to 20 per cent., is just to be put into effect. The company can make somewhat better deliveries, owing to having gotten into its shops tools which were late in coming. Trade for this year to date shows a great improvement over the corresponding period in 1899. A strong indication of the general prosperity is the fact that the Baldwin Locomotive Works expect to break their locomotive building record—946 in 1891—by turning out 1000 this year. Westinghouse, Church, Kerr & Co. have sold to the Solvay Process Company 36 Roney mechanical stokers, with economizers and induced draft apparatus. They have sold for installation at the Monongahela furnaces of the National Tube Company 2000-hp of stokers.

ELECTRIC RAILWAY ORDER FROM JAPAN.—The Keihin Electric Railway Company, of Kawasaki, Japan, has placed in this country a considerable order for an extension to its system. This railway, which is one of the earliest and most successful electric roads in the Far East, is at Kawasaki, which is midway between the capital, Tokio, and Yokohama, the principal commercial port of Japan. The business of the company has made such rapid strides that a considerable extension of track and equipment has been determined on. With this end in view Prof. Fujioka, who is well known in the United States as one of Japan's most distinguished and successful engineers, was retained as expert by the Keihin Company. He decided upon the use of storage batteries for the purpose of giving the necessary increase of effective power, and after long consideration placed through Takata & Co., of New York, the orders for car equipment with the Westinghouse Elec-

tric & Manufacturing Company, while the order for car trucks will be filled by the J. G. Brill Company, of Philadelphia, thus once more proving the deep-rooted belief held by Japanese engineers that the best electrical apparatus is of American manufacture.

COPPER PRODUCTION.—Mr. John Stanton, statistician for the copper producing companies, reports the production of fine copper for February and the two months ending February 28 in long tons (2,240 pounds) as follows:

	February.		Two months.	
	1899.	1900.	1899.	1900.
U. S., reporting mines	17,899	17,497	34,673	35,110
U. S., outside sources	2,000	3,400	3,850	6,800
Total United States	19,899	20,897	38,523	41,910
Foreign, reporting mines	7,399	.....	13,251	.....
Total	27,298	.....	51,774	.....
Exports, United States	8,391	12,749	17,595	26,784

The production of the foreign reporting mines has not yet been received. The United States production for the two months shows an increase of 3387 tons, or 8.8 per cent., over 1899; of this gain 437 tons only was from the reporting mines, 2950 tons being from the outside sources. The exports have been large this year, showing an increase of 9189 tons, or 52.1 per cent., over last year.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended March 10: Havre—328 cases electrical material $9229. Hamburg—49 cases electrical material $7521. Genoa—23 cases electrical material $1432; 10 cases electrical machinery $665. Glasgow—4 cases electrical machinery $190. Hull—6 cases electrical material $417. Japan—8 cases electrical material $45; 4 cases electrical machinery $135. London—126 cases electrical material $4748; 44 cases electrical machinery $2553; 12 cases electric motors $1046. Liverpool—23 cases electrical material $902. Marseilles—34 cases electrical material $2755. Antwerp—131 cases electrical material, $3885; 17 cases electrical machinery $1960. Barcelona—4 cases electrical machinery $22. Aberdeen—204 cases electrical material $2573. British Possessions in Africa—12 cases electrical material $1317. Brazil—22 cases electrical machinery $2937; 115 cases electrical goods $5508. Bristol—93 cases electrical material $8000. British West Indies—9 cases electrical material $289. Central America—47 cases electrical material $1820. Chili—222 cases electrical material $2401. China—34 cases electrical material $556.

FAN MOTORS FOR EXPORT.—The busy season for manufacturers of fan motors is at hand and this year's output promises to far surpass that of any previous year. One of the gratifying features of this line of manufacture is the rapidly increasing export demand for these goods, particularly from warm countries, where electricity is rapidly coming into use. In many cases the foreign business is as large as the domestic. The Falcon Electric Manufacturing Company, of New York, has just booked an order for 1000 fan motors to be sent to London, England. A few days ago the same concern sold a supply house 700 electric fans for the Mexican market. The South American market is an extensive field, and both English and German export houses are to-day said to be supplying that market with many American electrical specialties, for the reason that direct representation by manufacturers in South America (principally River Plate and Brazil) is limited. It is stated that in a number of instances many of the electrical supplies sent from here to London, Liverpool and Hamburg are for reshipment to foreign countries.

THE HONOLULU RAPID TRANSIT AND LAND COMPANY.—Extensive purchases of equipment for its electric railway have been made by the Honolulu Rapid Transit & Land Company, through Messrs. H. Crossman & Bro., of this city. Among the contracts already placed are those for 3000 tons of rails, given to the Pennsylvania Steel Company. The generators and motors have been purchased from the Westinghouse Electric & Manufacturing Company. Twenty-seven cars will be furnished by the American Car Company and eight cars are to be furnished by the Duplex Car Company. The trucks have been purchased from the J. G. Brill Company. Three 260-hp water tube boilers have been purchased from Babcock & Wilcox, and three 300-hp Hamilton Corliss engines were bought from Hooven, Owens & Reutschler. The Diamond State Steel Company will furnish a considerable quantity of rods, spikes, bolts, etc. Mayer & Englund furnish the copper bonds, and Milliken Bros. received contracts for steel trusses, etc., and a steel stack which are valued at $267,000.

INDUSTRIAL EXPANSION.—One of the indications of the present general expansion in business operations is the establishment by manufacturing companies of branches or offices in territory in which they have heretofore not had direct representation. As examples, we may note that during the past few weeks the Berlin Iron Bridge Company, of East Berlin, Conn., has opened an office in the Stephen Girard Building, Philadelphia, with Mr. L. H. Brumbaugh in charge; the Emerson Electric Manufacturing Company, of St. Louis, has established a branch office at 136 Liberty Street, New York, in charge of an officer of the company; the Robbins & Myers Company, of Springfield, O., is about to take an office in New York, to be in charge of Mr. W. B. Van de Water; and the Wagner Electric Mfg. Co., of St. Louis, Mo., has opened an office in the Havemeyer Building, New York, and placed it in charge of Mr. Edward E. Goudey.

MATERIAL FOR THE UNDERGROUND RAILWAY.—Mr. J. B. McDonald, the contractor for the New York Underground Rapid Transit Railway, is inviting bids for material for the construction of various sections of the tunnel. The specifications call for steel beams, underground, 21,729 tons; steel beams, riveted, 20,047 tons; steel beams, viaduct, 23,168 tons; cast iron, 7901 tons; steel rails, 4064 tons; iron pipe, 1000 tons. There will also be required ten station elevators and eight pumps. The specifications call for 304,801 lineal feet of 80-pound rails. The deliveries of steel, of which between 70,000 and 80,000 tons will be required, will extend over two or three years.

THE WELLMAN-SEAVER ENGINEERING COMPANY, of Cleveland, reports that it is at work on a number of important contracts for electrical equipment from abroad, among them an equipment of electrical machinery for the open hearth steel plant and rail mill for the Imperial Steel Works of Japan; an electric traveling crane of 200 feet span for a new steel works at Micheville, France, and some large electrical machines for the Spanish Government.

ELECTRICAL DEVELOPMENT AT THE "SOO."—O'Keefe & Orbison, hydraulic engineers and mill architects, of Appleton, Wis., are preparing plans for the development of about 40,000-hp of electrical energy at the Sault Ste. Marie. The enterprise is under the direction of the Edison Sault Electric Company, who will use the power for electric lighting and for lease to various manufacturing plants at the Soo.

IN THE MACHINERY MARKET.—The General Electric Company has concluded the purchase of a good batch of tools, says the *Iron Age*, amounting to something like $25,000. These tools will be erected at Schenectady, but it is also said that this company will soon require a larger assortment of tools for its new Canadian shops.

THE HAWAIIAN ELECTRIC COMPANY, LTD., of Honolulu, it is announced will shortly be in the market for one seventy-five-ton compound condensing engine compressor, with condenser coils and coils for one ten-ton ice tank. They are also shortly to purchase a thirty-ton per day boiling and distilling plant.

AMERICAN ENGINE SHAFT FOR GLASGOW.—The Glasgow Street Railway Company, of Glasgow, Scotland, has given to the Cleveland City Forge & Iron Company, Cleveland, Ohio, an order for a 35-ton engine shaft. The shaft will be 25 feet long, and its diameter will vary between 26 and 27 inches.

TELEPHONE IMPROVEMENTS IN CHICAGO.—The Chicago Telephone Company has purchased property on Wabash Avenue near Twenty-second street, paying therefor $47,500. It is stated that the company will erect a fine exchange building on the site.

OPPOSITION TO ERIE TELEPHONE.—It is reported from Milwaukee that a meeting of independent telephone companies has been called for March 20 to combine in opposition to the Erie Telephone Company's Wisconsin branch.

ADVANCE OF WAGES.—The National Tube Works, of McKeesport, Pa., last Monday advanced the wages of its 3,500 employees 10 per cent. The skilled workmen in the rolling mill department also expect an increase of 25 cents a ton, commencing April 1.

CROSS OIL FILTERS FOR JAPAN.—The Burt Manufacturing Company, manufacturers of the Cross oil filters, Akron, O., has just received from Yokohama, Japan, one of the largest orders taken so far this year.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., is placing orders for universal milling machines and other machine tools. The company expects to move into its new works at Waverly, N. J., about July 1 next.

BOILERS FOR CHICAGO EDISON.—The Heine Safety Boiler Company has sold to the Chicago Edison Company four water tube boilers of 574-hp at Chicago, and two 440-hp boilers to the Mahoning Valley Railway, Youngstown, O.

THE ERIE CITY IRON WORKS has sold to the City of Frankfort, Ind., for municipal and commercial lighting purposes two four-valve engines of 200 and 400-hp and tubular boilers of 700-hp.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER, March 10, 1900.

FIRE IN A LONDON CENTRAL STATION.—Serious damage has been caused to the central station of the Strand Electricity Supply Corporation, Limited, by a fire which came near reducing the whole station to ashes. As it was, several dynamos have been put out of active service for some time, and the switchboard is a total wreck. The premises are situated at the back of the Adelphi Theatre, in the midst of a mass of buildings, and it is a wonder that anything was saved, so narrow and intricate are the surrounding thoroughfares. Urgent efforts have kept the station running, however, and with a lot of temporary repairs it is hoped that no serious inconvenience will result.

ELECTRICAL ENTERPRISE IN ENGLAND.—It is encouraging to note that the Lancashire electric power bill has passed its second reading in the House of Commons, and has been referred to a private committee for further consideration. This is the bill which, along with a series of other similar bills, has been previously referred to in these columns. The private companies which are seeking rights by means of these bills to establish large power plants in various parts of the country where coal is cheap, are promising to sell current in bulk at a maximum price of 2d. per Board of Trade unit, as against the charges large municipalities and private companies are making to-day, which vary from about 4d. to 7d. or 8d. per unit. It is almost needless to state, however, that these bills are being opposed most bitterly by the various local authorities through whose towns the mains would have to run, on the plea that as Parliament has already granted them municipal rights it would be wrong for a private enterprise to be allowed to compete with them. A similar bill was killed in Parliament last year, and it is, therefore, gratifying to note that there is some possibility that these bills will be passed this year with certain modifications. The electrical industry in England has undoubtedly, during the past 15 years, been nearly throttled by parliamentary interference, and there is no doubt that something will have to be done very soon to allow of advance of electrical enterprise in this country. Certain modifications, however, would have to be introduced, as it would be as dangerous to grant large monopolies for the supply of electric current in various parts of the country as it would be to grant the municipalities the only rights.

METROPOLITAN ELECTRIC SUPPLY.—The report of the directors of the Metropolitan Electric Supply Company, Limited, for 1899, to be presented at the meeting to be held in London on March 13, states that the capital expenditure, which at the end of 1898 amounted to £993,761, has now reached £1,244,254, an increase of £250,492, the result being an excess of expenditure over receipts of £18,977. The principal item of expenditure was for the new works at Willesden. A portion of this expenditure was provided for by the issue of £125,000, being half of a new 3½ per cent. mortgage debenture stock which the directors considered it expedient to create. The gross revenue amounted to £179,190, against £151,605 in 1898, an increase of £27,584. The cost of generation, which in 1898 was £76,736, amounted to £90,419, an increase of £13,683. During the whole of the period under review the erection of the company's new generating station at Willesden was proceeded with, but owing to delays in the deliveries of constructional and other iron work the completion of the works was seriously hindered, with the result that from early in October to Dec. 15, when they commenced to supply current, the resources of the Manchester Square station were unduly taxed, and it was found necessary to temporarily withdraw the supply from certain of the circuits at hours of maximum demand. The balance to the credit of the revenue account, before providing for depreciation, is £66,393. The directors have set aside £13,000 as an addition to the depreciation and reserve fund, carrying to the credit of the net revenue account £53,393, which, with the balance brought forward and other receipts makes £57,728. After deducting debenture and share interest and other charges there appears a balance of £25,660. An interim dividend of 5s. per share on the ordinary share capital was paid in August, and the directors recommend a further dividend of 5s. per share, making a total distribution of 10s. per share for the year, or 5 per cent. on the capital. This will absorb £21,250, and leave £4410 to be carried forward. This result the directors consider to be satisfactory in view of the exceptional circumstances under which the working has been carried on during the year.

General News.

THE TELEPHONE.

COSHOCTON, OHIO.—The Citizens' Telephone Company has increased its capital stock from $10,000 to $30,000.

PRESTON, MINN.—The village council granted John Kingsley a 20-year franchise for a telephone exchange.

MEADVILLE, PA.—The independent telephone line between Meadville and Cambridge Springs has been opened.

UTICA, N. Y.—The Herkimer County Telephone Company has opened communication with Mohawk and Ilion.

WARREN, OHIO.—The Warren & Niles Telephone Company has decided to extend its line from this place to Vienna.

RICHMOND, IND.—Owing to a telephone war in this city party line instruments can be had for 50 cents per month.

SAN ANTONIO, TEX.—H. M. Aubrey and others will construct a telephone system, with a capacity of 2000 instruments.

HARTFORD, KY.—The Rough River Telephone Company has been incorporated. Dr. J. R. Pirtle is secretary and treasurer.

BITTINGER, MD.—A franchise has been granted to the Garrett County Telephone Company to build a line from Bittinger to Grantsville.

KAUKAUNA, WIS.—The Wisconsin Telephone Company, which presented a petition to the council, will probably be refused the license.

SWEETWATER, TENN.—The Sweetwater Telephone Company and the Meigs County Telephone Company will build several miles of toll lines.

JACKSON, MICH.—The Rural Telephone Company, of Waterloo, has filed articles of incorporation. The capital stock of the company is $10,000.

GALVESTON, TEX.—A bill has been introduced in the City Council granting a franchise to Bosart & Kramer to erect and maintain a telephone system.

TUSCUMBIA, ALA.—The Southern Bell Telephone Company, of Sheffield, has decided to give the Tuscumbia patrons of the system a separate exchange.

SCRANTON, PA.—A new toll line tariff schedule on a "three-minute basis" has been adopted by the Central Pennsylvania Telephone & Supply Company for business houses.

HENDERSON, N. C.—The Carolina & Virginia Telephone Company has been incorporated, with capital stock of $10,000, by P. Strause, F. C. Toepleman and J. B. Bridgers.

WARREN, OHIO.—The Bell Telephone Company has decided to build a line from Cortland to Burghill, Kinsman, Bristolville and West Farmington, at a cost of $40,000.

MILWAUKEE, WIS.—The Wisconsin Telephone Company reports a net gain of 386 subscribers in February, making a total number of subscribers on Feb. 28, 16,611.

CHARLESTON, S. C.—The South Carolina Telephone Company, which is putting up its lines through Columbia, is looking to a considerable extension through South Carolina.

GRAND FORKS, S. D.—The Long Distance Telephone Company has begun putting in a line from this city to Larimore, and a number of other extensions are provided for.

JACKSONVILLE, FLA.—The Southern Bell Telephone Company has authorized the expenditure of $20,000 in this city, placing the exchange here in first class working order.

RALEIGH, N. C.—The Raleigh Telephone Company has been incorporated; capital $1500, with privilege of increasing to $1,000,000. William Wynne will probably be general manager.

BRIDGEPORT, OHIO.—The Belmont Telephone Company has been incorporated. Capital, $15,000. Incorporators, J. D. Heinlein, J. B. Driggs, J. C. Dent, A. Heinlein, R. B. Mitchell.

McKEE, KY.—The McKee Telephone Company will extend its system as soon as possible throughout the mountains of Kentucky. The line will be 24 miles long. Mr. T. J. Coyle is president.

LOS ANGELES, CAL.—The Sunset Telephone Company announces that on March 26 the long distance telephone line between Tucson and Prescott, A. T., will be opened. The line is 278 miles in length.

COLUMBUS, OHIO.—The Miller City Telephone Company, of Miller City, has been incorporated. Capital, $5000. Incorporators: L. E. Deuble, F. H. Gerdeman, F J. Mersman, T. Schnelle and P. Lewis.

KOKOMO, IND.—The city council has granted a franchise to a competing company and service will hereafter be had of the Independent long distance and the Kokomo Telephone Manufacturing companies.

HIGGINS, TEX.—The Higgins, Lipscomb & Kiowa Telephone Company, of Higgins, has been incorporated. Capital, $20,000. Incorporators: A. Winsett, of Higgins; H. J. Holm, W. F. Peugh, both of Lipscomb.

COMMERCE, TEXAS.—The Commerce Telephone Company, with a capital stock of $5000, has been organized here. The incorporators are W. B. De Jernett, T. W. Thompson and D. W. Apperson, all of Commerce.

ROCKLAND, ME.—The Union Telephone Company, of Rockland, has been incorporated. Capital, $5000. Incorporators: F. E. Burkett, H. L. Robbins, L. M. Burkett, all of Union; A. S. Littlefield, attorney, Rockland.

DOVER, DEL.—The Gould Telephone Company, of Wilmington, has been incorporated. Capital, $100,000. Incorporators: E. M. Valentine, C. C. Gould, F. Wister, all of Philadelphia; J. W. Douglass, attorney, Philadelphia.

ST. JAMES, MINN.—A farmers' telephone exchange company is being organized in this county, with headquarters in St. James. The company proposes to give telephone service to farmers living within a radius of 10 miles from this place.

PITTSBURG, PA.—The Telephone, Telegraph & Cable Company of America has purchased for $220,000 cash the Union Telephone & Telegraph Company, which comprises all the independent telephone lines in Northwestern Pennsylvania.

RUSHFORD, MINN.—What was formerly the Rushford Telephone Company has been incorporated, and will hereafter be known as the Phoenix Telephone Company. The company will build new lines, put in a metallic circuit and otherwise improve the old line.

RAVENNA, OHIO.—A number of business men, headed by Hon. H. L. Beatty, are organizing a company to form an independent local telephone company. It is the plan to buy out the plant now controlled by W. H. Butler, on which an option has been secured.

ST. PAUL, MINN.—The Phoenix Telephone Company, of Rushford, has been incorporated. Capital, $50,000. Incorporators: G. E. Kirkpatrick, M. Miller, G. W. Rockwell, all of Rushford; J. C. Mills, of Preston; S. G. Iverson, of St. Paul, J. H. Vervati, of Houston County.

INDIANAPOLIS, IND.—The stockholders of the New Telephone Company

have re-elected the old board of directors and the following officers: President, A. H. Nordyke; vice-president, S. P. Sheerin; secretary, H. B. Gates, and M. B. Wilson, treasurer. The company has 4000 telephones in use.

WABASH, IND.—The stockholders of the Home Telephone Company of this city have voted to build toll lines, so as to connect with the New Telephone system, Indianapolis, the Fort Wayne and other northeastern Indiana points by way of the National Telephone Company's system.

LEBANON, OHIO.—The Independent Telephone Company, of this place, has extended its service all over Clinton County, operating in conjunction with the Clinton Telephone Company. The two exchanges will soon be placed in connection with long distance service through the United States Telephone Company.

TRENTON, N. J.—The Havana Telephone Company, to operate telegraph and telephone lines in Cuba and the West Indies, was incorporated here on March 12. Capital stock, $500,000. The incorporators are William J. Patterson, Edmund G. Vaughan and Edgar Park, all of New York, and Frank C. Prest, of East Orange.

CRAWFORDSVILLE, IND.—The co-operative telephone companies organized in the rural communities of western Indiana are proving highly successful and are rapidly multiplying. The monthly cost averages about 25 cents. The companies have connection with each other, but a small tax is levied on those communicating with patrons of other companies.

KANSAS CITY, MO.—The Independent Telephone Company, of Concordia, will soon have in operation a telephone connection with Rice, Ames, Clyde, Aurora, Miltonvale and Lamar, Hollis, Talmo, Belleville, Rydal, Scandia, Courtland, Republic City, Yuma and Jamestown. The last named will connect at Jamestown with the Beloit line, and the Clyde station will connect with Missouri River towns.

OSHKOSH, WIS.—The Oshkosh Northwestern Telephone Company, which recently sold out to the Wisconsin Telephone Company, retained some 550 telephones, which have now been sold to Jay A. Hinman and F. W. Bond, of this city, who states that they intend to organize an independent telephone company, to be known as the Citizens' Telephone Company and to put in another exchange here as soon as the necessary arrangements can be made.

CITY OF MEXICO, MEXICO.—The Mexican Telephone Company is preparing to construct a long distance telephone line from the City of Mexico to Guadalajara, a distance of over 200 miles. The posts, which will be of iron, have been ordered from the United States. This company proposes to do a great amount of construction work in Mexico during the present year. A number of the larger cities will be connected by long distance telephone before the close of the year.

OSHKOSH, WIS.—The Little Wolf River Telephone Company has presented a petition to the city council asking for a franchise in the city. Terms of the proposed franchise agreed that the company will not charge over $18 a year for house service and $30 for store and office service. Five free telephones are also promised for city service, and the company further agrees that it will not sell out its plant to any competitor without giving the city the first chance to purchase the franchise.

YORK, PA.—The York Telephone Company reports that the new multiple switchboard of 1200 metallic line capacity furnished and installed by the American Electric Telephone Company, of Chicago, is now in full operation, with the result that the service is greatly improved. Already a large increase in the number of subscribers has resulted directly from the rapid and perfect service afforded their patrons through the new multiple switchboard. The York switchboard is arranged for magneto call telephones, and has an ultimate capacity for 3000 lines.

TERRE HAUTE, IND.—Representatives of independent telephone companies in three States met here on March 7, and effected a permanent organization. The officers elected are Charles R. Duffin, of Terre Haute, president; J. L. Horney, of Clinton, Ind., vice-president; Henry A. Colt, of Terre Haute, secretary, and J. B. Connelly, of Rockville, Ind., treasurer. The new company is to be known as the Interstate Telephone Association and will start with the independent lines now in operation in Indiana, Illinois and Kentucky.

AUSTIN, TEXAS.—The Lone Star Telephone Company, with a capital stock of $500,000, has filed its charter here. It proposes to establish telephone exchanges in Galveston, Houston, Austin, San Antonio, Laredo, El Paso, Fort Worth, Whitesboro, Denison, Paris, Texarkana, Longview and Dallas. These towns and cities will be connected by long distance lines. The principal office of the company will be located in Austin. The incorporators are J. B. Earle, J. E. Boynton, of Waco; H. M. Aubrey and F. C. Smith, of San Antonio; W. H. Eager, James S. Brailey, Wauseon, Ohio; J. M. Longnecker, Delta, Ohio; W. H. Harper, Jr., John P. Bailey, Ottawa, Ohio; James King Duffy, New York City; W. A. Armstrong, Doniphan, Ohio.

BOSTON, MASS.—The instrument output of the Bell Telephone Company for the month ending Feb. 20, 1900, indicates a continuance of a growth in the company's business that is quite satisfactory for this season of the year. The falling off in the net output is slight, and not unexpected. The comparative figures for the month and for the two months of the fiscal year are given below:

Month ending Feb. 20:

	1900.	1899.	Inc.
Gross	58,272	49,262	9,010
Returned	23,414	13,476	9,938
Net	34,858	35,786	*928

Since Dec. 20:

	1899-1900.	1898-99.	Inc.
Gross	117,125	95,811	21,314
Returned	42,380	28,195	14,185
Net	74,745	57,616	7,129
Total outstanding	1,655,250	1,192,862	462,388

*Decrease.

ELECTRIC LIGHT AND POWER.

MARSHFIELD, ORE.—A vote will be taken on the subject of municipa. ownership of an electric light system of this city. Address City of Marshfield.

ALEXANDRIA, IND.—The Union Traction Company will build a new depot in this city.

BUNKER HILL, IND.—The town council have taken steps to light the city by electricity.

RICHMOND, IND.—The voters here will in May pass upon the question of establishing a municipal electric light plant.

LANCASTER, OHIO.—Council has passed an ordinance placing the electric light plant under the charge of three trustees.

HOUSTON, TEXAS, will want new plans for a 500 arc and 6000 incandescent plant. City Engineer Potter can give further information.

CANAJOHARIE, N. Y.—Surveys are being made by the Empire Power Company preparatory to erecting a dam three miles below Esperance.

GREENSBORO, ALA.—The Greensboro Water & Light Company is having plans prepared by Edward J. O'Beirne, of Birmingham for its proposed plant.

MARTINSBURG, W. VA.—The Bishop Electric Light & Power Company has applied for a franchise to erect and conduct an electric light and power plant.

TERRELL, TEXAS.—Plans and specifications are being prepared for a 600-hp electric, heating and steam plant for the North Texas Insane Asylum, at Terrell, Texas.

BIRMINGHAM, ALA.—The board of revenue of Jefferson County will establish a $3000 electric plant for lighting court house and county jail. Bids will be received.

OPELIKA, ALA.—The Alabama Electric Light & Power Company has awarded the contract for the construction of its plant to Edward J. O'Beirne, of Birmingham.

FREDERICK, MD.—C. L. Hahn, Aaron Rosenstock, J. Rogers McSherry and others are the incorporators of the Consumers' Electric Light, Gas, Heat & Power Company at this place.

RICHMOND, IND.—The question of municipal ownership of electric light plant, which has been agitated for some time, will be left to the people to settle. A vote will be taken May 8.

NORFOLK, VA.—The Norfolk Electric Light & Power Company has been granted a franchise and will establish a $300,000 plant. W. D. Pender is the vice-president of the company.

MURPHYSBORO, ILL.—The report of the engineer on the value of the electric light plant shows the property to be worth $134,948.37. It was recommended that the city purchase the plant.

TORONTO, ONT.—Mr. W. T. Stewart, electrical engineer of Toronto, Ont., has been engaged to prepare an estimate of the cost of an electric light plant for the town of Toronto Junction, Ont.

ST. CATHARINES, ONT.—The city of St. Catharines, Ont., is asking the Ontario government for power to raise $150,000, wherewith to acquire water powers for the development of electric energy.

BOSTON, MASS.—Dr. Edward Gahan, of this city, is reported to have purchased the electric light plant of Digby, N. S. It is his intention to add new dynamos and engine and to give an all-night service.

ILION, N. Y.—As the result of the charter election held here recently the taxpayers cast 425 for the municipal lighting proposition and 70 against. The plant will cost $30,000, for which bonds will be issued.

FRANKLIN, IND.—An injunction has been granted by the circuit court restraining the city from purchasing the electric light plant because the debt incurred will exceed the 2 per cent. constitutional limit.

SHELBURNE, N. S.—The Shelburne Power Company, of Shelburne, is applying to the legislature of that province for a charter to develop power for electrical purposes, on the Rosemay River, near the town.

WILMINGTON, DEL.—The Delaware Electric Light & Power Company has made application for permission to lay conduits and erect poles for wires, its object being to distribute electricity for light and power.

MORELIA, MEXICO.—The installation of an additional dynamo and 40 arc lamps in the city of Morelia, Mexico, has just been completed. The electric light plant there is now in good shape for efficient service.

TALLAHASSEE, FLA.—The city council has awarded the contract for the electric light plant to Moore & McCrary, for construction, and the General Electric Company, for machinery, both of Atlanta, for $17,500.

NEWBURGH, N. Y.—The Consolidated Gas, Electric Light, Heat & Power Company will increase its stock from $450,000 to $500,000, and bonds from $300,000 to $400,000, to buy out the Consumers' Gas Company.

FARGO, N. D.—The Hughes Electric Company has sold its plant to the Edison people. It is announced that $100,000 will be expended in improvements. General Hughes & Sons still retain large interests in the new company.

STEUBENVILLE, OHIO.—A committee of council and citizens has been selected by council to get an option on the Steubenville gas and electric plants with a view of purchasing and operating them under municipal ownership.

HAMILTON, ONT.—Contractors are figuring on the plans for the new works to be built by the National Cycle & Automobile Company at Hamilton Ont. The plant will cost $350,000, and there will be 1500 incandescent electric lights.

RICHMOND, VA.—W. E. Cutshaw, city engineer, wants estimates on a plant of 500 lights, wiring and boiler already in position, requiring engine, dynamo, steam, supply and exhaust pipes and proper connections with switchboards.

BELLEVILLE, ILL.—The city of Belleville is contemplating the purchase of an electric light plant. A council committee had a conference March 14 with Fred C. Postel, of Chicago, in regard to erecting one. He estimates the cost at $42,000.

ATLANTA, GA.—The Georgia Electric Light Company has purchased a brick building in which $100,000 worth of new machinery will be installed. An electric storage battery and three rotary transformers will be included in the equipment.

MINEOLA, TEXAS.—It is learned here that Walter Newton, of Jacksonville, has purchased the Mineola electric light plant, which has not been operated for several months, and that he will put in a new engine and start up the plant at once.

ST. LOUIS, MO.—The Citizens' Electric Light & Power Company has decided to locate its power house on the east side of the river and transmit its power to this side. Julius S. Walsh, president of the company, is in the east securing figures on the cost.

HAMILTON, ONT.—A company, to build electric launches, is being organized in Hamilton by Mr. S. R. Sintz, of Chicago, Ill., and Mr. A. Ives, of Detroit, Mich. The electric batteries for these launches will be made by the Volta Storage Battery Company, Hamilton.

JEFFERSONVILLE, KY.—The Jeffersonville Light & Water Company has mortgaged its new plant in Jeffersonville, franchise, lines, etc., to the American Trust and Savings Bank Company, of Chicago, to guarantee the payment of $58,000 worth of 4 per cent. bonds in 10 years.

VERA CRUZ, MEXICO.—The municipal council of this city has rejected the proposal of the old electric light company for a renewal of its contract for furnishing the city with lights. The contract, therefore, for electric lights for Vera Cruz is open for those who may wish to make proposals.

AUSTIN, TEXAS.—At a meeting of the stockholders of the Austin, Dam & Suburban Railway Company the following directors were elected for the ensuing year: W. A. and G. W. Barclay, W. B. Wortham and J. S. Myrick. George A Hill, general manager of the company, tendered his resignation, which was accepted.

INDIANAPOLIS, IND.—The St. Joseph & Elkhart Power Company has been incorporated with a capital stock of $150,000. The company proposes to dam the St. Joseph River to furnish electric power and light to the surrounding country. The directors are E. A. Saunders, James Du Shane, J. C. Eberhart, C. H. Tenuy, F. P. Delafield.

TORONTO, ONT.—A charter has been granted to the Central Ontario Power Company, formed for the purpose of developing electrical energy at Burleigh Falls, Ont., and for the purpose of constructing an electric railway in that vicinity. Among the incorporators are Hon. Richard Harcourt, J. A. Culverwell and F. W. Barrett, of Toronto.

ST. LOUIS, MO.—At the annual meeting of the stockholders of the Citizens' Electric Light & Power Company, held March 13, the following gentlemen were elected directors: Henry Nicolaus, Julius S. Walsh, William F. Nolker, W. J. Lemp, Adolphus Busch, Hopkins J. Hanford, Breckenridge Jones, S. M. Kennard, Aug. Gehner, Rolla Wells, Charles H. Turner, Philip Stock and Charles H. Liddie.

SAN FRANCISCO, CAL.—The Standard Electric Company, of California, is working a large force of men on its pole line extension from Stockton to Oakland. The new lines will pass through the Livermore Valley to Mission San Jose. From the last point one extension will be run to the city of San Jose and another to Oakland. Work is well under way on the Oakland substation and that in San Jose is completed. A large storage battery will be installed in each of these substations.

HARTFORD, CONN.—The Hartford Electric Light Company has made an offer for the stock of the old Light & Power Company, conditioned upon getting all the stock. The offer is at $10 per share. The Light & Power Company is leased to the Hartford Company and the managers of the latter hold already the controlling interest in its securities, both stock and bonds. It is understood that the larger interests have already been secured, and the probability is that the rest will come in. The par value of the stock is $25.

ST. LOUIS, MO.—The annual meetings of the Sedalia Electric Light & Power Company, the Moberly Gas & Electric Company and the Sedalia Gas & Fuel Company, all controlled by the same parties, were held in St. Louis March 14 for the purpose of electing directors and officers. The same directors and officers were selected for each company, as follows: James Green, president; Moses Rumsey, vice-president, and George R. Blackford, secretary. These with Judge G. A. Madill, were elected directorrs.

MARYSVILLE, CAL.—Mr. John Martin, of the Yuba Electric Power Company, has obtained control of the Marysville Gas & Electric Company. Electric power will be supplied to the Gas & Electric Company by the Yuba Electric Power Company under a 40-year contract. Henry Malloch will be secretary and manager, and M. C. Osborne, superintendent under the new management. A call has been issued for a stockholders' meeting, for the purpose of voting upon the question of issuing 30-year bonds in the sum of $100,000. The meeting will be held in Marysville, May 8.

NEWARK, N. J.—Stockholders of the United Electric Company of New Jersey in Newark elected these directors: A. B. Carlton, F. M. Stillman, William J. Davis, E. F. C. Young, A. Q. Garretson, Henry Mehl, John C. Rankin, Jr.; Goddfried Krueger, Joseph D. Bedle, Peter Hauck, Jr., A. P. Hexamer, Charles A. Sterling, Charles M. Decker, William H. Corbin and John F. Kehoe. The directors met later and elected these officers: Mr. Carlton, president; Lewis Lillie, of Philadelphia, treasurer; Dudley Farrand, general manager, and T. J. George, secretary. The United Electric Company controls the electric lighting and power plants of Newark, Jersey City, Kearny, Bayonne, Hoboken, Elizabeth, Montclair, the Oranges, Bloomfield, Belleville, Harrison, East Newark, Arlington, Irvington and Clinton, as well as those in the smaller places in the same territory.

THE ELECTRIC RAILWAY.

OSWEGO, N. Y.—Mr. Frank Arnold, of Watertown, has been appointed manager of the Oswego Traction Company.

INDIANAPOLIS, IND.—Plans are now under consideration for an electric railway between Indianapolis and Columbus, Ohio.

ROCHESTER, N. Y.—The Rochester & Sodus Point Electric Railway Company has decided to build its power house in Sodus.

SAN JOSE, CAL.—The First Street electric railway line in this city has been abandoned by its owner on account of not paying expenses.

MONTREAL, QUE.—The Montreal Street Railway Company proposes to put its feeders underground, and will spend about $200,000 on the work.

PINE BLUFF, ARK.—M. R. Roberts, of Independence, Mo., has secured a franchise to build the proposed electric street railroad.

NEW ORLEANS, LA.—On March 29 a street railway franchise will be sold at public auction to the bidder offering the highest percentage of gross annual receipts.

MANCHESTER, VA.—The Virginia Railway & Development Company has decided to build an extension of its electric line from Richmond into Manchester.

ALBION, MICH.—F. W. Rowley, representing the Kalamazoo Valley Electric Street Railway Company, has applied for an electric railway franchise through the city.

SAN ANTONIO, TEXAS.—The West End Street Railway Company is making some substantial improvements in its line which runs from this city to the suburb of West End.

OAKLAND, CAL.—Messrs. A. S. McDonald and William G. Henshaw, of Oakland, Cal., have applied for an electric railway franchise from the Alameda County line to Port Richmond.

RICHMOND, IND.—The Indiana Trust Company, of St. Louis, owners of the Richmond Street Railway Company, will ask for a right of way to extend the line over the national road to Dublin.

TOLEDO, OHIO.—City Solicitor M. R. Bridley has brought suit against the Toledo Traction Company, operating all car lines within the city, for 1 per cent. of the gross receipts since March, 1889.

WASHINGTON, D. C.—The Washington & Falls Church Electric Railway Company has determined to extend its trolley line to West Falls Church. R. H. Phillips, of Washington, is general manager.

PITTSBURG, PA.—The contract for the branch lines of the Pittsburg & Birmingham Traction Company is ready to be let. There are seven miles of new road to be built at a cost of about $300,000.

MANCHESTER, N. H.—Residents of East Manchester have petitioned the management of the Manchester Street Railway Company to extend the Valley Street line through certain streets in that place.

PARRAL, MEXICO.—Mr. James P. Lawrence, an American, is organizing a company with a view of establishing a street railway system in this city. Mr. Lawrence is now in Chicago on business relating to the project.

DAYTON, OHIO.—The Dayton, Troy & Northern Electric Railway Company, of Dayton, has been incorporated. Capital, $10,000. Incorporators, W. F. Fackles, F. M. Compton, H. E. Randall, W. W. Chapman, J. J. Hall.

ST. LOUIS, MO.—The building of the monster power plant of the St. Louis Transit Company in this city is nearing completion and within 40 days some generators will be running. It will be the largest power house in the west.

KANSAS CITY, MO.—During the recent cold weather considerable trouble was experienced on the cable lines of the Metropolitan Street Railway Company by the closing of the slots due to the cold. Some slight accidents resulted.

COLUMBUS, OHIO.—A franchise has been granted to the Columbus & Lancaster Traction Company, to operate and maintain a street railway in this city, and also from the south corporation line of Columbus to the city of Lancaster, Ohio.

SAN FRANCISCO, CAL.—The San Francisco & San Mateo Electric Railway Company has been granted a franchise within the limits of San Mateo City. The company already has a franchise outside the city limits and is operating cars as far as Colma.

INDIANAPOLIS, IND.—The Logansport, Rochester & Northern Traction Company has increased its capital stock to $1,000,000. The contract for the construction of the road has been let. The bonds will be marketed by the Indiana Trust Company.

LOUISVILLE, KY.—The Louisville Railway Company, it is understood, has decided to make a number of important improvements to its present electric line, and will probably expend about $200,000 during the present year. T. J. Minary is president of the company.

ALBANY, N. Y.—The Eighth & Columbus Avenues Connecting Railway Company, of New York City, has been incorporated. Capital, $50,000. Incorporators, J. S. Bames, Jr., P. Jay, T. Robins, Jr., T. DeW. Wells, all of New York City; F. S. Rollins, of Pelham; H. A. Robinson, attorney, New York City.

PHILADELPHIA, PA.—Contracts for 100 new open cars for the coming summer have been awarded by the Union Traction Company. This order brings the number of new cars either placed in service or in process of construction since the first of last year up to about 3500.

MANSFIELD, OHIO.—The Mansfield, Savannah & Wellington Electric Railway Company, which is planning to build a line from this place to Wellington to connect at that point with the Cleveland, Elyria, Berea & Oberlin Electric Railway, has secured a franchise to enter the central part of this city.

ROCHESTER, N. Y.—There is considerable opposition along the line of the Rochester & Suburban Railway to the proposed change from steam to electric power. It is necessary to get the consents of the property owners to the change, and when they are asked to sign an agreement they demand money.

BIDDEFORD, ME.—Col. Charles H. Prescott, who for some time has owned a control of the Biddeford & Saco Electric Railroad stock, has formed a syndicate and steps will be taken at once to continue the work of improving the rolling stock and equipment recently begun, and for extending the line.

VERA CRUZ, MEX.—The street railway system of this city has passed into the hands of S. Pearson & Son, Limited, British contractors. It is the intention of the new owners to completely rejuvenate the entire system, and it is probable that electric power will be substituted for the present animal power.

CHATTANOOGA, TENN.—The Chattanooga Rapid Transit Company has executed a mortgage for $300,000 on its tracks, franchises, rolling stock, etc. This transaction includes the refunding of $200,000 bonds and the further loan of $100,000 with which to complete the line to Chickamauga Park and to equip the same.

NEW YORK, N. Y.—The Rapid Transit Commissioners have instructed the chief engineer to investigate the practicability and cost of the extension of the rapid transit tunnel in Manhattan Borough to Brooklyn Borough, by way of the Battery. Ten thousand dollars have been appropriated to cover the expense of the work.

ROCHESTER, N. Y.—The Rochester & Sodus Bay Electric Railway Company has stopped operations on its line because of the fact that some property owners along the line want to be paid for the right of way in front of their property. The company threatens to run the road from Williamson to Poultneyville and then to Sodus Bay along the lake shore.

HOBOKEN, N. J.—The Ridgefield & Teaneck Railroad Company has been merged with the Bergen County (N. J.) Traction Company, which runs a trolley line from Fort Lee. The union was made under the name of the Hudson River Railway & Ferry Company, with $1,500,000 capital. The Fort Lee Ferry Company was also purchased by this trolley company.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company has purchased a plat of land adjoining its present power house on Second avenue, and is preparing plans for an extensive addition. It is said that another large unit will be put in. The company is also preparing plans for extensive car barns and repair shop on Fairmount street, and two of the existing lines will be extended to centralize at this point.

CITY OF MEXICO, MEX.—The reconstruction of the street railway line from Tacubaya to San Angel, both suburbs of the City of Mexico, has been completed and electric service is now in regular operation between these two points. The company has received permission to erect poles on the banks of the canal from the Indianilla power house to San Antonio Abad for the wires to convey the power for the operation of the Tlalpam cars.

PITTSBURG, PA.—The consolidation of the three largest local traction companies in this city is now practically completed, and all that remains to be done is for the stockholders to vote on the proposition. The new company will be known as the Union Traction Company, of Pittsburg, and will consist of the Consolidated Traction Company, the United Traction Company, and the Monongahela Traction Company. The stockholders will vote on the question of consolidation on March 31.

SHERMAN, TEXAS.—The syndicate of Chicago capitalists which recently purchased the street railway system of Denison, Texas, has just purchased the two street railway lines in this place. The work of constructing an interurban line between the two places will be commenced as soon as arrangements can be completed. The new line and other improvements will cost about $400,000. The company is organized under the name of the Denison & Sherman Interurban Electric Railway Company.

ST. PAUL, MINN.—The report of the Twin City Rapid Transit Company for 1899 shows the following results: Receipts—Gross earnings, $2,522,793.85. Expenses—Operating, $1,156,972.37; interest on debt and taxes, $628,242.88; dividends on preferred stock, $187,553.34; dividends on common stock, $375,250.00; total, $2,348,018.59; surplus, $174,775.26. The company has authorized the construction of 100 new cars. These cars and other contemplated improvements will aggregate a cost of $500,000.

SEATTLE, WASH.—In pursuance of an order of the court, the opponents of the 35-year street railway franchise asked for by Jacob Furth and J. D. Lowman recently filed a bond in the sum of $1000, required of them in the injunction suit brought by them against the above named and the city council of Seattle, Wash. The bond is to cover any damages that may arise through the decision of the court enjoining Messrs. Furth and Lowman from acting under the franchise, provided they acquire it. The case will be determined in the Supreme Court.

ST. LOUIS, MO.—The threatened strike of street railway employees in this city has been averted by an agreement betwen the transit company and its employees. The company concedes ten hours to be a working day, to be completed within twelve hours, at 20 cents an hour; will so arrange the work of the "extras" as to do away with their grievances, the men to receive half pay while waiting for their run; where an employee is shown to have been discharged because of his connection with the union, he is to be reinstated; all grievances of men will be carefully considered and corrected by the company. The demands of the men, with the exception of that demanding recognition of their organization, with some minor moderations, have been conceded.

THE AUTOMOBILE.

THE FRIEDMAN AUTOMOBILE COMPANY, with a capital stock of $100,000, has been organized at Chicago.

MESSRS. RUSSELL & CO., Massillon, Ohio, it is stated, will commence the manufacture of automobiles under the patents of Mr. C. O. Heggan, superintendent of the firm.

THE VICTORIA MOTOR VEHICLE COMPANY, of Indianapolis, has been been incorporated. Capital, $25,000. Incorporators: J. H. Murphy, V. Carman, O. H. Carman, all of Indianapolis.

THE BUFFALO ELECTRIC CARRIAGE COMPANY, of Buffalo, N. Y., has been incorporated with a capital of $20,000. The directors are Frank A. Babcock and Isidore Mitchell, of Buffalo.

THE FOSTER AUTOMOBILE MANUFACTURING COMPANY, of Rochester, has been incorporated, with a capital of $100,000. Directors—G. G. Foster, Thomas H. Yawger, and Clinton D. Martin, Rochester.

THE ELECTRIC LOG RECORDER COMPANY has been incorporated at San Francisco, Cal. Capital, $30,000. Incorporators: F. M. Munger, L. W. Storer, L. T. Jones, W. B. Armstrong, all of San Francisco; J. Mills, of Oakland.

THE INTERNATIONAL ANDERSON MOBILE COMPANY has been incorporated at Charleston, W. Va., to deal in automobiles, with capital stock of $2,000,000, by G. E. Morris, G. W. Walmuth, A. F. Bouton and others, all of New York City.

THE CRANDALL ELECTRIC MONOGRAM COMPANY, of New York City, has been incorporated. Capital, $50,000. Directors—Lucien S. Crandall, Silas B. Dutcher, James R. Davies and Norman S. Dike, Brooklyn; J. W. Riglander, New York City.

AUTOMOBILES IN MARYLAND.—A bill has been introduced in the Maryland Legislature to incorporate the Maryland Automobile & Manufacturing Company, with a capital stock of $5000. The incorporators are S. B. Harcom, Joseph Borrow, Alex S. Stern, Milton Jacobi and John C. Bossel.

THE MALTBY AUTOMOBILE & MOTOR COMPANY, of New York City, has been incorporated for the purpose of manufacturing and dealing in automobiles. Capital, $1,000,000. Incorporators: C. C. Hoge, C. A. Mackenzie, P. R. Brooks, F. D. Maltby, E. L. Maltby, all of New York City.

NEW INDUSTRIAL COMPANIES.

THE DETROIT ELECTRO-PLATING COMPANY has been incorporated at Detroit, Mich. Capital, $10,000. Incorporators: H. G. Harris, G. McClusky, M. W. Mueller, W. H. Thayer, all of Detroit.

THE YONKERS ALTERNATING ARC LAMP COMPANY has been incorporated in New Jersey. Capital, $125,000. Incorporators: L. A. Rodenstein, N. A. Flannery, both of New York; C. A. Durfee, of Yonkers; R. Surbridge, attorney, New York City.

THE BURKE TELEGRAPH & CABLE COMPANY, of New York City, has been incorporated. Capital, $800,000. Incorporators: H. Cummins, W. A. Weed, R. Sherwood, C. G. Franklin, W. H. Land, all of New York City; H. Cummins, attorney, New York City.

THE FAY BELTING COMPANY, of New York City, has been incorporated to deal in leather belting, hose, etc. Capital, $5000. Incorporators: G. W. Rowbotham, of Boston, Mass.; W. C. Fay, of New York City; McD. DeWitt, of Brooklyn; A. C. Thayer, attorney, New York City.

THE AUTOMOBILE DRY ACCUMULATOR COMPANY, of Hutton Park, N. J., has been incorporated to deal in electric batteries, etc. Capital, $10,000. Incorporators: A. Meister, A. Junker, both of New York; F. M. Eppley, of West Orange; F. M. Eppley, attorney, New York City.

PERSONAL.

MR. W. J. JOHNSTON arrived at Colombo, Ceylon, Feb. 15, from which place he will proceed to Calcutta and thence across India to Bombay.

MR. EDWARD E. GOUDEY, in charge of the foreign department of the Wagner Electric Manufacturing Company, of St. Louis, has established his headquarters in New York, with offices in the Havemeyer Building.

MR. W. B. WOOD, recently connected with the Cornell Machine Company at Chicago, has resigned his position to become the Chicago agent of the Weber Gas Engine Company, of Kansas City, Mo. Mr. Wood expects to open an office shortly in the Monadnock Block.

MR. A. MILLER BELFIELD has been taken into the firm of Charles A. Brown & Cragg, the patent firm of Chicago. He is a graduate of the Chicago Manual Training School and of Purdue University, and has already for some years been engaged in the practice of patent law.

MR. J. KAJIURA, of Tokyo, Japan, electrical engineer to the Japanese Government Department of Communications, is on a visit to the United States to take note of late electrical engineering advances. During his stay in the United States Mr. Kajiura will visit the more important electrical plants and manufacturing works.

MR. W. B. VAN DE WATER has accepted the position of manager of the Eastern Sales Department of the Robbins & Myers Company, of Springfield, Ohio. The wide acquaintance of Mr. Van de Water with the fan and motor trade makes his services a valuable acquisition and particularly at the present time in view of the large increase of manufacturing capacity of the Robbins & Myers Company, which has just added a new and complete factory to its plant.

GEN. C. H. BARNEY, long connected with electrical enterprises and more lately associated with the New York Telephone Company, has decided to give his time and energies to the exploitation of "Kilfyre," the dry compound made by the Monarch Fire Appliance Company, of 27 William Street, New York, for extinguishing fire. It was shown at the last Electrical Exposition, and is especially adapted for extinguishing fires in electrical apparatus. General Barney will work in the electrical field for the company.

MR. J. H. VAIL, a well known consulting and supervising engineer, has opened an office at 1107 Walnut Street, Philadelphia, where he will conduct a mechanical and electrical engineering business. Mr. Vail is one of the old Edison men, his work in the electrical field dating back as far as 1880, at the now

historic Menlo Park laboratory. He was chief engineer and general superintendent of the Edison parent company from 1881 to 1893, and has charge of the construction for isolated plants, central stations and electric railways. From 1896 to 1900 he was engineer-in-chief of the Philadelphia Electric Companies. It is evident, therefore, with all this experience that his qualifications to conduct his new enterprise are of high order.

OBITUARY.

BERNARD M. SHANLEY, a financier and contractor of Newark, N. J., and well known to electric light and street railway people through his connection with enterprises of these characters in New Jersey, died at his home on March 19. He was born in Newark, Nov. 1, 1847.

JAMES G. SMITH, a well known telegraph pioneer and inventor, died at his home in New York on March 13, at the age of 64. He entered the telegraph service in 1850 as a messenger and soon afterward became an operator, being one of the first operators to receive by sound. Mr. Smith was selected to introduce in the West the first automatic repeater, which was invented about 1856 by Farmer and Woodman. In 1863 he was made assistant to General Marshall Lefferts, engineer of the American Telegraph Company, and while in this position inaugurated a complete reform in the operation of city lines. He was associated with Mr. Joseph B. Stearns, the inventor of the duplex, in the commercial development of that apparatus. Mr. Smith in 1877 entered the electric light business with William E. Sawyer, in which he was engaged for a few years. He afterward organized the Continental Telegraph Company and established the rapid stock exchange service between New York and Philadelphia. This company was afterward absorbed by the Western Union. In 1881 Mr. Smith organized the Bankers' & Merchants' Telegraph Company, which failed in 1885, as the result of the Grant & Ward failure, and was connected at the same time with the United States Telephone Company, which was fighting the Bell Telephone Company. Since 1885 Mr. Smith has given his entire attention to telephone matters and developed a system whereby the number of circuits for serving a given number of subscribers is largely reduced, with consequent reduction of cost for conductors and in exchange operation. Mr. Smith was born at Durham, N. H., April 14, 1836, and was president of the Smith-Vassar Telephone Company at the time of his death. His remains were buried in Portland, Me.

Trade Notes.

THE FEDERAL INSTRUMENT COMPANY, of Albany, N. Y., will soon be in the market with several new types of electrical instruments.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has opened a New York office in the Havemeyer Building, which will be in charge of Mr. Edward E. Goudey.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., has leased two large buildings which are being equipped with machinery for the manufacture of car trucks.

THE BUCKEYE ENGINE COMPANY, of Salem, Ohio, has received through its eastern agents an order for a large vertical engine for Bagnall & Hillis, at Manila, Philippine Islands.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is anxious to have the names of alternating station managers who have not received a copy of its little pamphlet describing Gutmann wattmeters.

THE WRIGHT MANUFACTURING COMPANY, of Cleveland, Ohio, manufacturer of steam specialties, has increased its capital stock from $25,000 to $50,000. The plant and business of the company will be expanded.

GEORGE W. HOFFMAN, 295 Washington Street, Indianapolis, Ind., manufacturer of the U. S. Metal Polish, is building up a considerable business in the export trade. Recently several large foreign orders have been shipped.

THE VANCE ELECTRIC COMPANY.—John Cheever has been appointed receiver of the Vance Electric Company, electrical contractors, 136 Liberty Street, New York, in proceedings for the voluntary dissolution of the corporation.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, of Utica, N. Y., is placing a line of new switches on the market. It is prepared to build single-throw or double-throw switches of any amperage according to specification.

ENCLOSED ARC LAMPS.—John S. Nowotny, 105 East Pearl Street, Cincinnati, is sending to central stations and the trade a circular announcement of a considerable reduction in the price of Nowotny enclosed arc lamps for 110 and 220-volt direct current circuits.

THE NATIONAL CARBON COMPANY, of Cleveland, Ohio, is manufacturing all sizes of carbons for enclosed and open arc lamps, both cored and solid, for direct and alternating currents. The company claims that its carbons are superior to any imported goods.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., opened an office at Rooms Nos. 909-910 Stephen Girard Building, Philadelphia, Pa., on March 15. It is in charge of Mr. L. H. Brumbaugh, who has been with the Bridge Company for a number of years.

BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in Bulletin 33A, describes and illustrates its type H, belted, direct-current multipolar generators. The machine is illustrated complete and in detail, and tables give the principal dimensions of the various sizes.

THE HAZARD MANUFACTURING COMPANY of Wilkesbarre, Pa., has recently issued a pamphlet giving much tabular information concerning Keystone rubber-covered wire and cables. The pamphlet contains many tables of an engineering and mathematical character, which will be found very handy for reference.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, has just brought out a twenty-four-page circular in three colors, for distribution among users of rubber goods. This company is the manufacturer of the well-known "Rainbow" packing which is claimed to make steam joints instantly.

J. C. FAGAN, of Watertown, N. Y., has made some extensive improvements on his cut-out switch. This switch, which is for the regulation of incandescent and arc lamps, is unique in that it is placed on the ceiling and can be operated by a cord. Although he has been in business but a few years, the demand for his switch on the part of electricians has become very extensive.

THE WESTERN ELECTRIC COMPANY is sending out to its trade price lists on electrically heated devices. The following named apparatus is carried in stock: Electric curling iron heater, soldering irons, immersion coil heaters, glue pots, smoothing irons, portable stoves or disc heaters, heating pad, electric broiler, griddle cake cookers, tailors' electric irons and electric radiators.

THE STANDARD ELECTRIC COMPANY, of Cincinnati, is furnishing about 10,000 feet of cable and 100 miles of wire for the work of changing the local telephone system from the multiple board to the common battery system. Manager Lawrence, of the company, is in Chicago looking after some important business in which the firm is interested.

POLES AND OVERHEAD MATERIAL.—Manager McCallum, of the Electric Railway Equipment Company, Cincinnati, reports increasing inquiry for poles and overhead material. Some heavy orders have been filled during the past two weeks of material to be used in construction work on the continent of Europe, the Argentine Confederation and Brazil.

THE STANDARD TOOL COMPANY, of Cleveland, Ohio, in a recent catalogue, gives price lists and complete dimensions of its products, which consist of twist drills, reamers, chucks, taps, milling cutters, special tools, etc. Manufacturers of electrical apparatus would, no doubt, find a copy of this catalogue valuable to have handy for reference.

THE FEDERAL BATTERY COMPANY, 11 Pine Street, New York, announces that Federal Salts are now being used by the fire alarm companies all over New York City, and that there is also being prepared for the war department a shipment of Federal Salts for the Philippine Islands. The demand has recently been so heavy that the company has been compelled to nearly double its working force.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has added a new and complete factory to its former plant. This addition has a floor space of $30,000 square feet, and is being fitted up with the most modern equipment throughout to be used for the construction of ceiling, desk and bracket fans, motors and dynamos. A New York office will be opened, with Mr. W. B. Van de Water in charge.

THE GENERAL ELECTRIC COMPANY has just issued Bulletin No. 4216, which is devoted to direct driven continuous current lighting generators. The bulletin is illustrated with views of this type of generator, together with diagrams of dimensions. Price lists of expulsion fuse blocks and fuses, arc lamp accessories and incandescent street system brackets, and sockets and receptacles for lamps with Edison screw bases have also been issued by the company.

THE CARLISLE & FINCH COMPANY, of Cincinnati, find the demand excellent for searchlights just now. This company has a practical monopoly of the searchlight business of the Pacific Coast. It is making some exceptional lights for steamers on the Ohio and Mississippi rivers and on the Great Lakes. The last big shipment made was to Puget Sound parties. Another profitable article with this firm is the gas engine sparker put on the market about a year and a half ago.

THE BURNLEY BATTERY & MANUFACTURING COMPANY, of Painesville, Ohio, reports that the sales of the Burnley soldering paste have been beyond all expectations during the past year, and as its present methods of manufacture are inadequate to meet the growing demand, the company has just arranged with a Chicago firm to make some special apparatus to increase the capacity and facilitate the manufacture of this popular product.

FOWLER & ROBERT, 149 Broadway, New York, are manufacturing all street railway supplies formerly produced by the Lewis & Fowler Manufacturing Company and the reorganized company, under the name of the Brooklyn & New York Street Railway Supply Company, of Elizabethport, N. J., these latter concerns having gone out of business. Messrs. Fowler & Robert handle everything in the way of street railway supplies and have had 20 years' experience in the manufacture of registers.

VICTOR TELEPHONE APPARATUS.—The Victor Telephone Manufacturing Company, Chicago, Ill., has just issued an illustrated brochure of Victor products, which contains views of the various departments of its offices and factory and illustrations of its complete line of telephone apparatus. It is an interesting publication, and, being somewhat out of the ordinary style of trade literature, it will, no doubt, attract extraordinary attention. Portraits of the officers and staff are also included.

THE ELECTRICAL APPLIANCE COMPANY, of Cincinnati, Ohio, has closed a number of large contracts for its new intercommunicating telephone system. Mr. Churcher, of the firm, says the company is working its forces night and day to get out orders. One of the first orders for its entire desk set came from one of the largest manufacturing establishments in Chicago. Other large orders of the week were placed in New Orleans and Detroit. The company is already figuring on enlarging the shop space.

ELECTRICAL HOUSE GOODS.—The 1900 edition of the catalogue of Partrick, Carter & Wilkins, 125 South Second Street, Philadelphia, contains 60 pages, and lists a complete line of house goods. One feature that will appeal to the electrician consists of several wiring diagrams for return call bell systems and interior telephone systems. We learn from an announcement in the catalogue that this firm since 1867 has installed its annunciators and alarms in upward of 75,000 hotels, banks, offices, dwellings, etc.

GENERAL ELECTRIC PUBLICATIONS.—Among recent publications of the General Electric Company are a pamphlet on marine electrical apparatus, to which reference is made elsewhere; a bulletin of the lighting department on feeder potential regulators; a bulletin of the railway department on the G E-67 railway motors; a small bulletin ("flyer") on outlet blocks and bushings, and another on assembled commutator segments for Edison bipolar dynamos; and price lists of puncher clip and snap switches, and high-tension, quick-break "form B" switches.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has issued its 1900 perpetual catalogue. This year's catalogue is much more complete than that of last year and contains much matter that will be of general interest to the electrical trade. The various styles of rheostats and controllers manufactured by the company are very completely illustrated and briefly described, and price lists of this apparatus are also given. There are several diagrams showing the methods of connection, which will be of particular value to those interested.

RUSHMORE PROJECTORS.—The Rushmore Dynamo Works, Jersey City, N. J., are building over 100 projectors for all classes of service, and state that orders are in hand for nearly all important vessels now under construction. The searchlight fire engine they recently furnished to the New York Fire Department has proved to be of enormous value in fighting fires in tall buildings, and they are now in correspondence with the fire officials of a number of other large cities, and it is expected that this branch of their business will soon be of considerable importance.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, is quite as thorough in getting up its catalogue, as it is in the construction of its apparatus. Its latest catalogue gives a clear description of the construction of this company's line of generators and motors, and points out the particular features of these machines, which have made them so well known. The engravings are particularly fine, and show the details of the apparatus very clearly and effectively. Machines of the various styles are shown complete, and many cuts show special applications of Triumph motors.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, having one of the best equipped lighting supply departments in the country, is able at this season of the year, when all lighting plants are contemplating improvements and extensions, to fill orders on shortest notice with the best class of material. The latest thing it has secured is the agency for the Williams' electric time switch, which is something to be appreciated by all central stations. It will cut out automatically fan circuits, lights or motors, and can be locked so it cannot be tampered with. Absolute certainty can then be had as to the time a customer is using current.

MARINE ELECTRICAL APPARATUS.—The latest production of the "General Electric Press" is a pamphlet on marine electrical apparatus which typographically and in printing and binding well sustains the high reputation of the printing department of the General Electric Company. The pamphlet contains 64 pages and more than a hundred half-tone illustrations of marine electrical apparatus, appliances and fittings. These latter, together with the text, which, though brief, is concise and covers much ground, will give the reader a comprehensive idea of the applications of electricity aboard ship aside from those relating more particularly to naval warfare.

FRED M. LOCKE, of Victor, N. Y., is busy manufacturing a large order of 60,000-volt insulators, to be shipped to the Pacific Coast. A new factory is being put up at Victor, which will greatly facilitate the filling of his rapidly increasing orders. An insulator, recently made by Mr. Locke, was tested at the Stanley Works, in Pittsfield, Mass., in the presence of a number of experts and manufacturers. The insulator stood a pressure of 240,000 volts. Mr. Locke stated that those present felt like taking their hats off, when they saw an insulator under a ¾-inch aluminum cable heated to incandescence, and ice cold water being poured on, without the least sign or breaking down.

THE STEPHENSON MANUFACTURING COMPANY, of Albany, has struck upon a unique plan of calling attention to the advertisements they carry in several leading technical journals. As soon as the papers in which they advertise reach their office, they immediately send out postal cards to every advertiser in each paper respectively, reading something like this: "Your advertisement on page 89 is good. I can offer no criticism. Did you see ours on page 14?" Of course, the curiosity of a man receiving such a card leads him to look up page 14 in the paper in question. Mr. Kellogg states the returns from this unique way of calling attention to the Stephenson Manufacturing Company have been beyond expectation.

DAY LOAD FOR CENTRAL STATIONS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., is offering to central stations and dealers an opportunity to obtain copies of a handsome pamphlet for distribution among their customers, entitled "A Faithful Servant." The pamphlet has been compiled with an idea of assisting central stations and dealers to secure customers in other lines than incandescent lamps. The book is furnished to central stations and dealers with their imprint at the mere cost of printing, the rate being one cent a copy in lots of 3000 or more. The pamphlet, which is well written and illustrated, is intended to appeal to the lay reader, and points out electrical applications for home convenience.

THE NATIONAL CARBON COMPANY.—At the meeting of the board of directors of the National Carbon Company, held last week, some extensive improvements to the Cleveland plant were decided upon. The contemplated improvements include an extensive building, which will add from 40,000 to 50,000 square feet to the present plant. Large improvements are also being made at the company's plant at Ravenna, Ohio. The equipment of the St. Louis plant recently closed is being removed to that point and the complete buildings of the plant at Mahoning, Pa., are being re-erected there. It is interesting to note that the structural steel from this building was originally taken from the main buildings at the Philadelphia Centennial in 1876. A large equipment of new machinery for the manufacture of carbon specialties is also being put in at Ravenna.

THE STERLING ELECTRIC COMPANY, Lafayette, Ind., is the exclusive manufacturer of Bell style telephone apparatus for all classes of service. The company has just issued a pamphlet which gives in a general way some idea of the apparatus manufactured by it. A brief description of switchboards, drop parts, etc., are given, together with some excellent illustrations of the apparatus. Some large boards are shown. Protective devices are also described and illustrated, as well as pole terminals. The telephones manufactured by this company are claimed to have great power, unusual distinctness of enunciation and a freedom from all sensitiveness to all foreign sounds. The transmitters and receivers are electrically efficient and possess several points of novelty, which will commend themselves upon inspection. Every telephone manager will, no doubt, find much in this pamphlet of interest.

ONONDAGA DYNAMOS.—The best evidence that a machine is giving satisfaction, that it is well built and correctly designed, is the fact that after a concern has used a machine of a certain make for years it buys other machines of the same make. This, the Onondaga Dynamo Works, of Syracuse, N. Y., says, is pre-eminently true of its machines. One concern, which has used the Onondaga dynamos and motors for years, has given the company seven duplicate orders for machines of different sizes and capacity. Nearly every company which has bought an Onondaga dynamo or a motor has duplicated its order when in need of another machine. The company has recently shipped a 1200-light, 75-kw machine to the I. A. Hall Company, of Paterson, N. J. This is to be direct connected to a Watertown steam engine. Another machine of the same size and capacity is installed at the Columbian Cordage Mills, Auburn, N. Y. The engineer of this latter company states that the machine has never given him a moment's trouble since its installation.

PASS & SEYMOUR, of Syracuse, N. Y., are now installed in their new factory. The plant is located within 20 feet of the New York Central Railroad. A side track runs right along the whole southern side of the factory, giving ample and convenient shipping facilities. The factory has three floors, with plenty of light and room, and is heated by exhaust steam. There are two kilns, of very large capacity; another kiln is soon to be built. As an evidence of the foresight of this company a fireproof vault has been built, where the dies are stored. If the factory should burn down, they could be in operation inside of 60 days. All the Pass & Seymour insulating specialties are made here. As Mr. Salisbury, the able and thorough manager of this company, said: "We manufacture everything we sell—we don't buy the pieces and put them together and call that manufacturing." The fact that the business of this company has increased 400 per cent. within the past two years is an evidence that they make something that the trade wants. One unique thing in the office of this company is a Columbia phonograph. Mr. Salisbury uses this for dictation. He is very enthusiastic in his praise of this machine. "It is time and money saved, to say nothing about its convenience," he said. "I can keep two stenographers busy all day by dictating to this machine, and then handing the cylinders over to them for translating into letters. It is a wonder to me why more offices don't use them."

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MARCH 13, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

645,055.—APPARATUS FOR PRODUCING CAUSTIC SODA; H. S. Anderson, Springfield, Mass. App. filed Feb. 23, 1899. (See Current News and Notes.)

645,057. HANGER FOR ELECTRIC CEILING FANS; W. H. Ayers and E. Groth, West Hoboken, N. J. App. filed July 20, 1899. To prevent the vibrations of the fan from being communicated to the building, the hanger is provided with a block of yielding material through which the connection is made between the fan and the beam supporting it.

645,066. METHOD OF ELECTRIC WELDING; R. P. Brown and F. E. Moore, New York, N. Y. App. filed March 16, 1898. The method of welding or brazing together flatwise metal pieces, having different characteristics, which consists in holding the pieces together at the seam or joint, and concentrating heat from two external heat sources upon the metals at opposite sides of the joint, the relative thermal intensities at the point of concentration being so proportioned that the metals of the parts are brought to their respective welding or brazing temperatures at approximately the same time.

645,088. ELECTRIC MOTOR CONTROL; W. R. Hamlen, of Johnstown, Pa. App. filed April 18, 1899. The method of control consists in shifting a plurality of motors from a series relation of their elements to a multiple relation, by intermediate steps in which one element of each motor is connected in multiple with the corresponding element of the other motor or motors, the other elements being in series. These steps enable the use of the resistance and counter electromotive force of the motors to advantage in changing them from series to multiple.

645,089. APPARATUS FOR CONTROL OF ELECTRIC MOTORS; W. R. Hamlen, Johnstown, Pa. App. filed April 19, 1899. This patent contains claims for the apparatus for carrying out the method described in the previous patent.

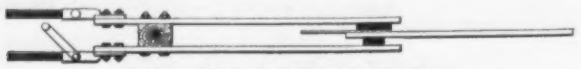
645,092. SNAP SWITCH; G. W. Hart, West Hartford, Conn. App. filed April 21, 1899. Details of construction affording a simple and compact switch, adapted to be inserted in a cavity and to be operated by two push buttons.

645,103. ELECTRIC CIRCUIT CONTROLLER; B. M. Jones, Orange, N. J. App. filed July 21, 1899. This is an electro-mechanical device for controlling a rheostat from a distance and extends to the varying of the resistance to any extent or maintaining it at any value at will. The mechanism compre-

hends two solenoids, one of which moves the arm of the rheostat while the other actuates a brake which controls the action of the first solenoid.

645,116. ELECTRIC MOTOR CONTROL; F. A. Merrick, Johnstown, Pa. App. filed April 19, 1899. A modification of the method described in patent No. 645,088.

645,117. ELECTRIC MOTOR CONTROL; F. A. Merrick, Johnstown, Pa. App. filed April 19, 1899. Apparatus for carrying out the method described in the previous patent.



645,066.—Method of Electric Welding.

645,125. ALTERNATING CURRENT METER; W. H. Pratt, Lynn, Mass. App. filed June 7, 1899. (See Current News and Notes.)

645,126. ELECTRIC METER; L. C. Reed, New Orleans, La. App. filed July 10, 1899. (See Current News and Notes.)

645,127. SYSTEM OF ELECTRIC METERING; L. C. Reed, New Orleans, La. App. filed July 10, 1899. (See Current News and Notes.)

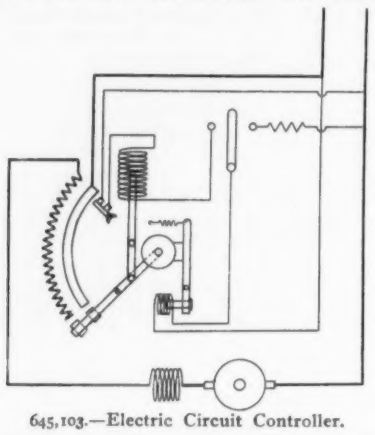
645,128. SYSTEM OF ELECTRIC METERING; L. C. Reed, New Orleans, La. App. filed Nov. 2, 1899. (See Current News and Notes.)

645,129. SYSTEM OF ELECTRIC METERING; L. C. Reed, New Orleans, La. App. filed Nov. 3, 1899. (See Current News and Notes.)

645,130. ALTERNATING CURRENT MOTOR; W. G. Rhodes, Salford, England. App. filed Nov. 22, 1899. (See Current News and Notes.)

645,186. TROLLEY HEAD; E. J. Rauch, Brockton, Mass. App. filed May 24, 1899. Contact springs which bear against the hub of the trolley wheel are secured to the top of the trolley pole by means of slits formed therein, into which the ends of the springs are inserted.

645,187. WIRE CONDUIT TUBING; C. B. Richmondt, Milwaukee, Wis. App



645,103.—Electric Circuit Controller.

filed Nov. 20, 1899. An electro-galvanized iron or steel tubing having a flexible, non-corrosive and insulating coating adhering to the zinc.

645,198. PROCESS OF PRODUCING INCANDESCENT MATERIALS SUITABLE FOR ELECTRIC LIGHTING; G. Alefeld, Darmstadt, Germany. App. filed Feb. 21, 1899. (See Current News and Notes.)

645,212. ELECTRIC LIGHTING APPARATUS FOR RAILROAD CARS; E. J. Preston and A. V. Gill, London, England. App. filed Jan. 2, 1900. This system involves a dynamo, two storage batteries, the lamps and a resistance interposed between the dynamo and the lamps, a hand switch interposed between the lamps and the resistance and provided with contacts arranged to cut out the resistance and connect the dynamo with both batteries when the lamps are cut out.

645,216.—ELECTRIC LIGHTING APPARATUS FOR RAILROAD CARS; W. F. Richards, Buffalo, N. Y. App. filed Nov. 16, 1899. The dynamo is suspended from the car by means of a pair of links and is belted to the axle. Devices are provided for shifting the position of the dynamo to change the tension of the belt, without affecting the angle of the suspension links or the gravity action of the dynamo.

645,247. METHOD OF STARTING ASYNCHRONOUS AND SYNCHRONOUS MONOPHASIC ELECTRIC MOTORS; E. Cantoni, Rome, Italy. App. filed July 7, 1899. (See Current News and Notes.)

645,249. BELL STRIKER; F. W. Cole, Newton, Mass. App. filed June 10, 1899. This is a clock train intended to operate the bell hammer for a long period. The electrical features merely consist of a circuit for tripping the train.

645,259. ELECTRIC THIRD-RAIL SYSTEM; George C. Hicks, of Chicago, Ill. App. filed July 10, 1899. A magnet on a car, acting through a non-magnetic rail, attracts a springy frame of magnetic material placed under each third-rail section. When attracted, the frame makes contact with the supply circuit, and also with a connection to the third rail, thereby permitting current to be taken from the rail for the operation of the car motors.

645,266. FASTENING DEVICE FOR HEADS OF ELECTRIC GLOBE LAMPS; J. Kremenezky, Vienna, Austria. App. filed March 10, 1898. Two projections are formed in the glass neck of the lamp and the metal base is provided with two seats for the projection and also with slots through which the projections may pass to the seats. The slots are afterward filled with solder.

645,284. METHOD OF ELECTRICALLY TREATING MATERIALS; E. G. Acheson, Buffalo, N. Y. App. filed May 23, 1899. (See Current News and Notes.)

645,285. METHOD OF MANUFACTURING GRAPHITE; E. G. Acheson, Buffalo, N. Y. App. filed Sept. 30, 1899. (See Current News and Notes.)

645,351. TROLLEY; T. Dennis, New Castle, Pa. App. filed July 22, 1899. The wire rests against a contact roller which is mounted on a shaft between two toothed wheels which are free to rotate independent of the roller. The function of the wheels is to keep the trolley on the wire.

645,384. RAIL JOINT TESTING APPARATUS; R. W. Conant, Boston, Mass. App. filed Nov. 13, 1899. Three portable circuit terminals are employed, two of which are to make contact with the conductor to be measured, and the other to connect with a known resistance in circuit with the unknown resistance. A telephone receiver is connected in a line which forms part of two metallic circuits whereby sounds produced by the making or breaking of one circuit can be compared with sounds produced by the making or breaking of the other circuit.

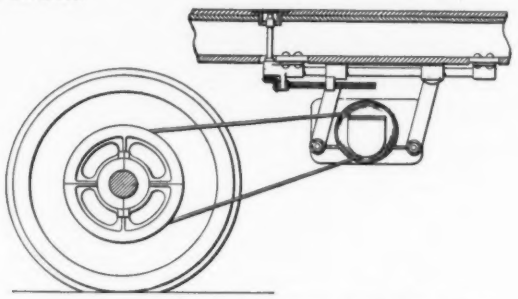
645,402. TELEPHONE EXCHANGE SYSTEM AND APPARATUS; John Z. Miller, of Erie, Pa. App. filed Dec. 12, 1899. Means are provided whereby a visual busy signal may be automatically given by the act of connecting up two subscribers, which signal will be maintained in operative position until the connection is removed. Another object is to provide means for preventing the return of the annunciator call drops to their normal positions after actuation until the call has been answered.

645,405. ELECTRICAL MUSIC BOX; J. Natterer, Jersey City, N. J. App. filed July 29, 1899. The object is to provide means controlled by the tune sheet for instantly and automatically actuating the impact devices for vibrating the teeth of the comb so that the sounding of the teeth depends upon the operation of a mechanism between the tune sheet and the impact devices for the comb.

645,419. SCALE DISSOLVER AND PREVENTER; H. C. Davis and H. Strasburger, Washington, D. C. App. filed June 26, 1899. The feed water of steam boilers passes first through this apparatus, which contains a series of positive and negative plates. It is claimed that the electrification of the water prevents the formation of scale in the boiler.

645,433. MAGNETIC PADS; J. F. Strange, New Bedford, Mass. App. filed Aug. 24, 1899. The pad consists of a hollow truncated cone of sheet rubber having a series of bar-magnets inserted in its sides.

645,478. ACCUMULATOR; Henry Leitner, London, England. App. filed March 25, 1898. Separating pieces of highly elastic material, such as celluloid, are placed between the plates of the storage battery; encircling parts bind the plates firmly together. One plate is of peroxide and the other of zinc, the latter being placed between the separating pieces and having a core of celluloid.



645,216.—Electric Lighting Apparatus for Railroad Cars.

645,499. ELECTRIC ARC LAMP; W. Vogel, New York, N. Y. App. filed Aug. 5, 1899. The regulating mechanism consists of a pair of solenoids, carbon disks pivoted to the ends of the cores of the solenoid, means for rotating the disk and a mechanism whereby a controlled motion of both carbon disks is obtained.

11,812. (Reissue.) RAIL BOND; C. J. Mayer, Philadelphia, Pa. App. filed Feb. 12, 1900. This is a reissue of patent No. 642,554, dated Jan. 30, 1900.

GERMAN PATENTS, ISSUED FEB. 28, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

107,533. ELECTRIC HEATER FOR INCANDESCENT BODIES; Walther Nernst, Göttingen. App. filed Oct. 2, 1897. An electric heater in proximity to the incandescent body is supplied with current not passing through the incandescent pencil. As soon as the latter is sufficiently heated, either the main current or an appropriate device cuts off this heating current.

107,470. CURRENT INTERRUPTER; Hermann Th. Simon, Göttingen. App. filed April 20, 1899. A liquid resistance having large electrodes is placed in the circuit, and the generally large cross-section of the resistance is cut down on one or several places between the electrodes to a very small cross-section.

107,677. ELECTRIC LIGHT; A. Vosmaer, Haarlem, Holland. App. filed Dec. 2, 1898. The permanent electrodes of the lamp consist of rods of nickel or nickel alloys, through which passes a current of small volume, but very high pressure. Light-emitting surfaces are produced thereby at the ends of the rods by the formation of layers of oxide of nickel. Only one light-emitting surface may be had by employing as one of the electrodes a metal, as, for instance, copper or zinc, which does not emit light.

107,442. GAS-TIGHT GLASS COVERING FOR IRON OR NICKEL WIRE; Schott & Genossen, Jena. App. filed Feb. 12, 1899. The wire pieces are put in a small glass tube from which the air has been exhausted and replaced by an inert gas, and then the glass is molten to the wire. In order to avoid the connecting and disconnecting of the glass tube to the gas supply, a rather long glass tube may be used, which is constantly filled with the inert gas and to one end of which the wire may be melted from time to time.

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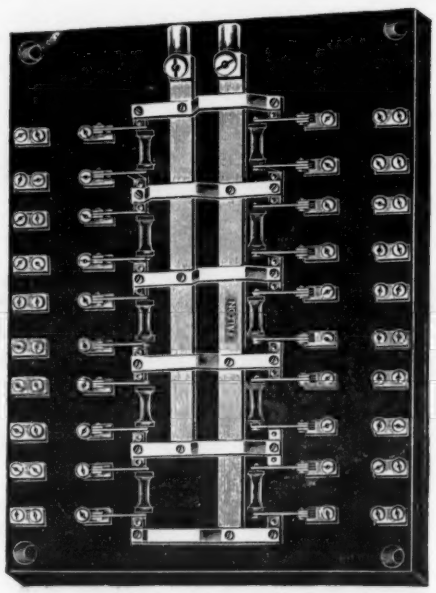

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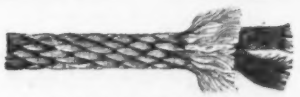

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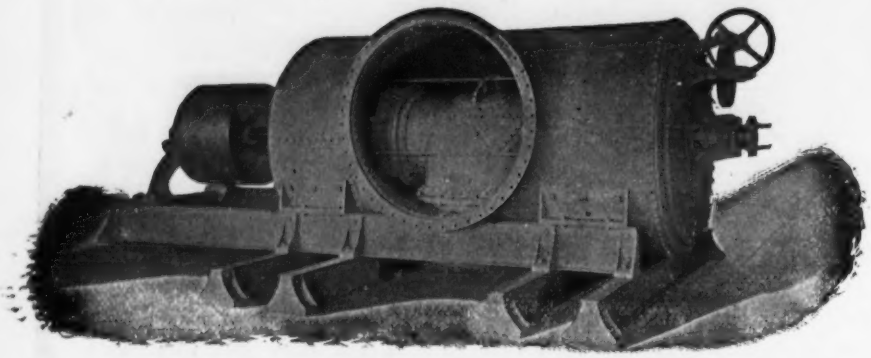

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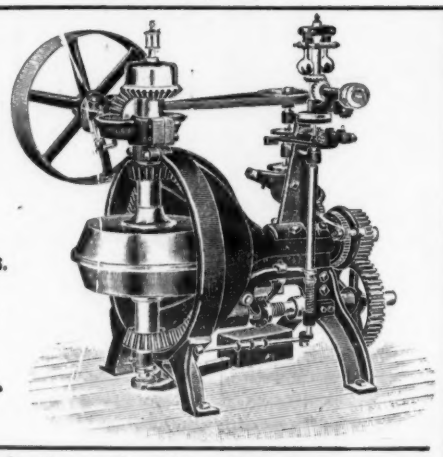

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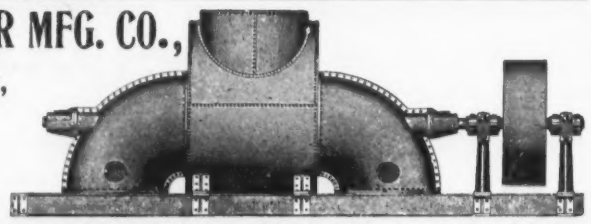

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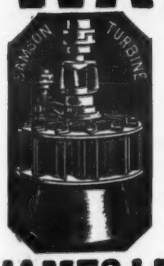

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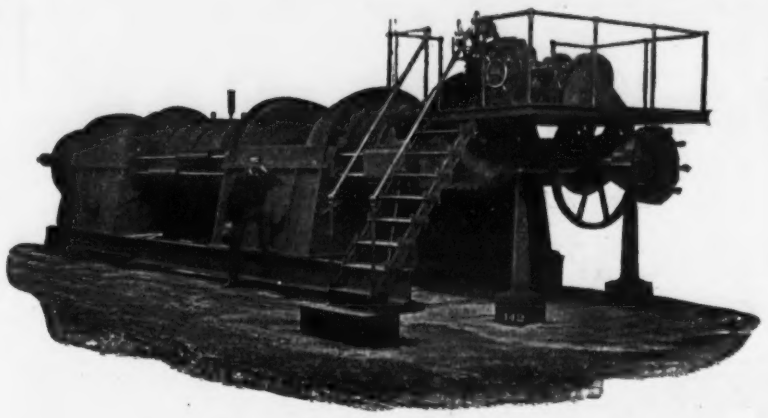

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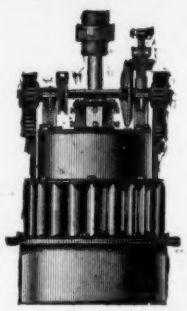

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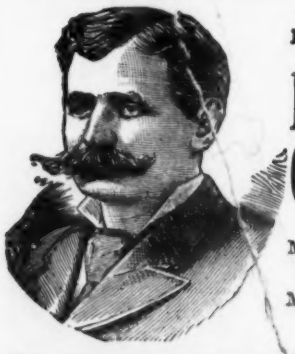
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